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REGISTER

OF THE

BALTIMORE POLYTECHNIC INSTITUTE.

1908-1909

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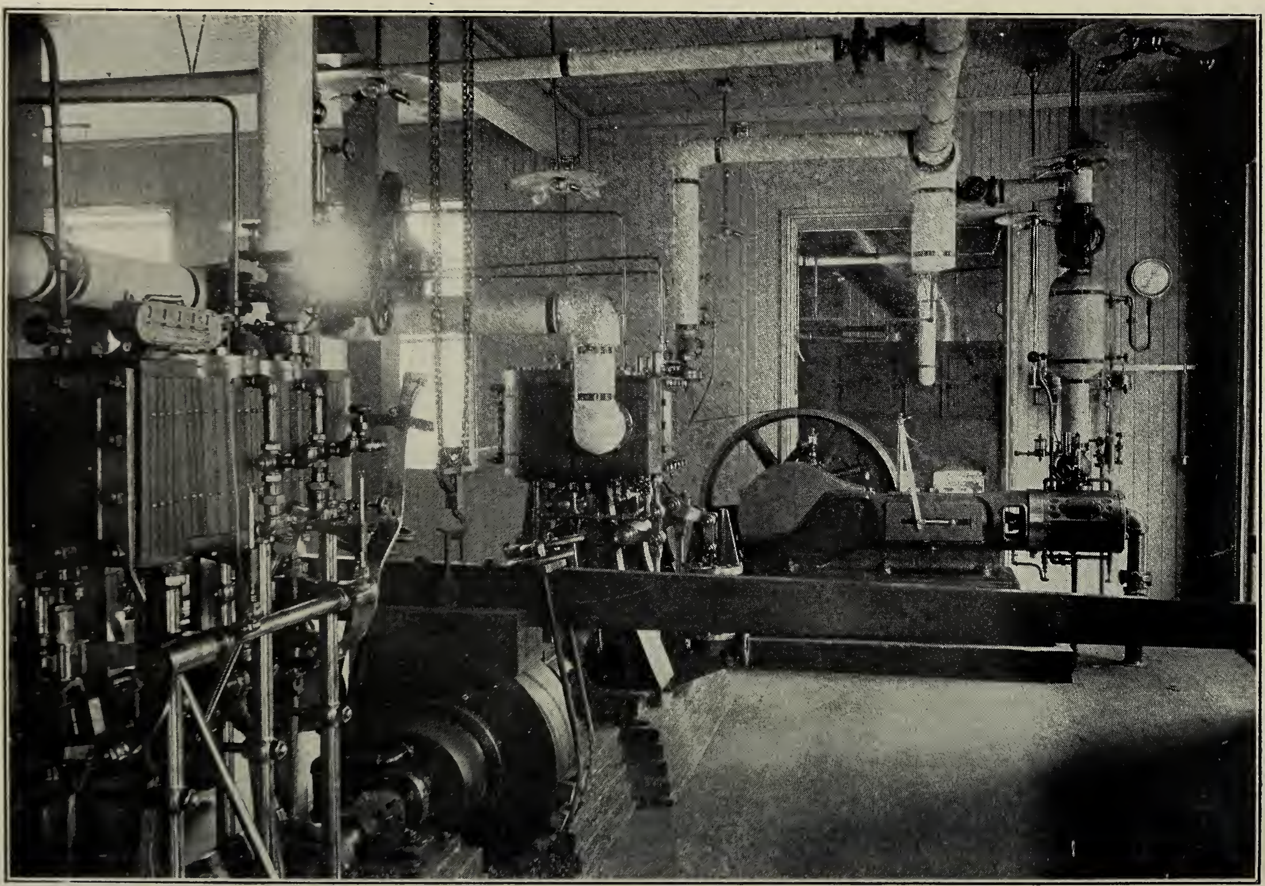

ENGINE AND BOILER PLANT, MECHANICAL LABORATORY

ANNUAL REGISTER

OF THE

Baltimore Polytechnic Institute

311-331 COURTLAND STREET

TWENTY-FOURTH
ACADEMIC YEAR

1908–1909

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BALTIMORE POLYTECHNIC INSTITUTE.

HISTORICAL SKETCH.

The Baltimore Polytechnic Institute, the second manual training school established in the United States as a part of a public school system, is one of the several educational institutions of the secondary grade maintained by the City of Baltimore.

Although it is believed that tentative efforts to engraft manual training upon the city's school system were made as early as 1873 or '74, yet the action which led to the establishment of this school was not taken until April, 1883. At a meeting of the Board of Commissioners of Public Schools, held on the 24th of that month, Mr. Joshua Plaskitt, Commissioner for the Ninth Ward, offered a resolution for the appointment of a committee "to consider . . . the advisability of establishing a school or schools for manual training." The resolution was adopted, and the committee thus appointed recommended the establishment of a school "for manual education." The necessary enabling ordinances and enactments having been passed by the City Council of Baltimore and the General Assembly of Maryland, the school was organized and opened on February 26th, 1884, under the name "Baltimore Manual Training School," with Dr. R. Grady as Director.

In January, 1886, the faculty was reorganized, Lieut. John D. Ford, an officer of the Engineer Corps of the United States Navy, who had been detailed for duty at the school, becoming Principal.

From the opening of the school applicants for admission had been required to pass through the eighth grammar school grade, or to show satisfactory evidence of having had equal instruction; but in September, 1888, it was decided to admit pupils of the 6th, 7th, and 8th grammar grades. This action opened the school to so large a number of young boys that increased accommodations became imperative, and in June, 1890, a new building, devoted to the academic studies and drawing, was finished and occupied.

Lieut. Ford was recalled to the naval service in June, 1890, and was succeeded as Principal by John W. Saville, a retired member of the Engineer Corps of the Navy.

In May, 1893, the name of the school was changed to "Baltimore Polytechnic Institute," and the titles of Principal and Vice-Principal to President and Vice-President respectively.

Mr. Saville resigned in August, 1899, and was succeeded as President by Lieut. William R. King, Engineer Corps, U. S. N., the present head of the school.

The new Charter of Baltimore went into effect on March 1st, 1900, and under one of its provisions it devolved upon the Mayor, Hon. Thomas G. Hayes, to appoint, as the head of the Department of Education, a Board of School Commissioners composed of nine persons, to serve without pay, and to be chosen from among those citizens he deemed "most capable of promoting the interests of public education, by reason of their intelligence, character, education, or business qualifications." The names of the distinguished citizens so chosen will be found on page 10.

Another provision of the Charter requires that "in order to secure the continuance of local interest in, and oversight of the public schools, there shall be appointed by said Board of School Commissioners such number of unpaid School Visitors as may be found requisite." In pursuance of this provision there was appointed as a Board of Visitors to this institution a group of gentlemen, some of whom are recognized in technical circles throughout the country as being at the head of their respective professions.

The members of the Board of Visitors had no sooner acquainted themselves with the general conditions prevailing in the school—the age and attainments of the pupils of the lower grades, the character of the work done, and the scope of the curriculum—than they submitted to the Board of School Commissioners a very comprehensive and exhaustive report discussing the conditions, needs, and aims of the school, and recommending certain changes in the requirements for admission, and in the curriculum. The partial adoption of this report in September, 1900, excluded grammar school pupils from the Institute, thus making the standard for admission the completion of the course prescribed for the Elementary Schools.

In April, 1901, a further consideration of the report of the Board of Visitors led to the practical addition of one year to the course by permitting graduates to remain for a year of post-graduate work; and in May, 1902, the length of the course was, by action of the Board, set at four years for pupils entering on and after September 15, 1902.

It was further provided that pupils leaving the Institute before the completion of the course should receive certificates of the work done by them up to the time of their withdrawal.

By operation of the new Charter the titles of President and Vice-President were changed, in 1900, to Principal and Vice-Principal.

BOARD OF SCHOOL COMMISSIONERS.

JOHN E. SEMMES, *President.*
ALCAEUS HOOPER,
REV. WILLIAM ROSENAU,
COL. A. B. CUNNINGHAM,
THOMAS McCOSKER,
EDWARD ROSSMAN,
DAVID D. KENNEDY,
GEORGE A. SOLTER, JR.,
ROBERT M. ROTHER.

BOARD OF VISITORS.

ABRAM H. COLMARY, *Chairman,*
FREDERICK W. WOOD,
FREDERICK J. MAYER,
JAMES L. MURRILL,
WILLIAM H. ROTHROCK,
MENDES COHEN.
FREDERICK H. WAGNER.

SUPERINTENDENT OF PUBLIC INSTRUCTION.

JAMES H. VAN SICKLE.

RECORD OF THE FACULTY AND STAFF.

ARRANGED IN ORDER OF APPOINTMENT.

William R. King, Passed Assistant Engineer, U. S. N. (retired), U. S. N. A., 1875. Principal and Head of Department of Engineering, September 1, 1899.

William H. Hall, B. C. C., 1885; A.M., Washington College, 1906. Assistant in Department of Science, September 23, 1886; Head of Department of Science, September 13, 1899.

William G. Richardson. Assistant in Department of Engineering, February, 1887.

J. Ward Willson, B. C. C., 1861; M.D., Baltimore University, 1889. Assistant in Department of English and Modern Languages, March 21, 1888.

George M. Gaither, B. M. T. S., 1888. Assistant in Department of Engineering, April 1, 1889; Supervisor of city manual training centers in addition to Institute duties, September, 1902.

Warren S. Seipp, B. M. T. S., 1891. Assistant in Department of Engineering, September, 1891.

Samuel M. North, B. C. C., 1887. Assistant in Department of Mathematics, September, 1894; Head of Department of English and Modern Languages, September 13, 1899

Samuel P. Platt. Assistant in Department of Engineering, October 1, 1897.

Oliver Bacharach, B. C. C., 1897. Assistant in Department of Mathematics, April, 1898.

J. Edward Broadbelt, B. M. T. S., 1890; Ph.G., Maryland College of Pharmacy, 1893. Assistant in Department of Science and Secretary of the Institnte, September, 1899..

John H. Bramble, B. C. C., 1897. Assistant in Department of Mathematics, October, 1899.

J. Montgomery Gambrill, B. P. I., 1897. Assistant in Department of English, June 11, 1902; resigned in 1904 to become Assistant State Superintendent of Education in Maryland; Head of Department of History and Civics, September, 1906.

Charles Ernest Conway, B. P. I., 1902. Assistant in Department of Engineering, June 11, 1902; at Lehigh University, 1903-1904; Assistant in Department of Engineering, September, 1907.

William L. DeBaufre, B. P. I., 1903; E.E., Lehigh University, 1907. Assistant in Department of Engineering, September, 1903; at Lehigh University, 1904-1905; Assistant in Department of Engineering, 1905-1906; at Lehigh University, 1906-1907; Assistant in Department of Engineering, January 1, 1908.

Irving L. Twilley, A.M., Washington College, 1892. Assistant in Department of English, September, 1903; transferred to Department of Science, June, 1904.

Henry A. Converse, A.B., Hampden-Sidney College 1893; Ph.D., Johns Hopkins University, 1903. Assistant in Department of Mathematics, May, 1904; resigned, September 1, 1906, to accept the chair of Mathematics at Davis and Elkins College; Assistant in Department of Science, June, 1908; Acting Head of Department of Mathematics, February 10, 1909.

Edward Reisler, A.M., Western Maryland College, 1888. Assistant in Department of English, May, 1904.

Elmer M. Harn, A.B., Rock Hill College, 1892; A.M., Rock Hill College, 1895. Assistant in Department of English, July, 1904.

Isaac L. Otis, A.B., New York University, 1899. Assistant in Department of English, September, 1904; Assistant in Department of History and Civics, September, 1906.

Allen L. Malone, B. P. I., 1902. Assistant in Department of Engineering, October 1, 1904.

Rowland Watts, A. B., Washington College, 1886; A.M., Washington College, 1888. Assistant in Department of Science, September, 1905; Head of Department of Mathematics, September, 1907; transferred to Department of Science, February 10, 1909.

Allan B. Souther, B.S., Harvard, 1907. Assistant in Department of Engineering, October, 1905.

Harvey S. Houskeeper, A.B., Lehigh University, 1872. Assistant in Department of Mathematics, September, 1906.

Henry Bogue, Jr., A.B., Johns Hopkins University, 1899. Assistant in Department of Engineering, September, 1906.

Thomas F. Garey, A.B., Washington College, 1904; A.M., Washington College, 1907; LL.B., University of Maryland, 1907. Assistant in Department of Mathematics, November, 1906.

George S. Wills, Ph.B., University of North Carolina, 1896; A.M., Harvard, 1898. Assistant in Department of English, June 3, 1907.

William H. Wilhelm, A.B., B.S., St. Johns College, 1893; A.M., St. Johns College, 1896. Assistant in Department of Mathematics, June 12, 1907.

James B. Arthur, B. P. I., 1904. Assistant in Department of Science, September 25, 1907.

William P. Stedman, A.B., Trinity College, 1905. Assistant in Department of English and Modern Languages, February 12, 1908.

Joseph Ellis Hodgson, A.B., Washington and Lee, 1898. Assistant in Department of Mathematics, June, 1908.

John H. Hills, B. P. I., 1905; M.E,, Lehigh University, 1908. Assistant in Department of Engineering, June, 1908.

Emanuel Fritz, B. P. I., 1905; M. E., Cornell University, 1908. Assistant in Department of Engineering, June, 1908.

Charles Frederick Ranft, A.B., Johns Hopkins University, 1902. Assistant in Department of History and Civics, June, 1908.

Philip Dougherty, B.S., Trinity College, 1907. Assistant in Department of History and Civics, June, 1908.

George N. Anderson, Pratt Institute, 1908. Assistant in Department of Engineering, September, 1908.

Powhatan Clarke, M.D., University of New York, 1858. Assistant to the Principal, September 1, 1908.

Othello Schroedl, B. P. I., 1908. Laboratory Assistant, September 1, 1908.

Nathan Lebovitz, Secretary, February 11, 1909.

FACULTY.

WILLIAM R. KING, *Principal,*
Head of Department of Engineering.

WILLIAM H. HALL,
Head of Department of Science.

SAMUEL M. NORTH,
Head of Department of English and Modern Languages.

J. MONTGOMERY GAMBRILL,
Head of Department of History and Civics.

HENRY A. CONVERSE,
Acting Head of Department of Mathematics.

DR. POWHATAN CLARKE,
Assistant to the Principal.

NATHAN LEBOVITZ,
Secretary.

FACULTY AND STAFF BY DEPARTMENTS.

DEPARTMENT OF ENGINEERING.

William R. King, *Head of Department.*

William L. DeBaufre,
Charles E. Conway,
John H. Hills,
Samuel P. Platt,
Henry Bogue, Jr.,
Allan B. Souther,
William G. Richardson,
Emanuel Fritz,
Allen L. Malone,
George M. Gaither,
Warren S. Seipp,
George N. Anderson.

DEPARTMENT OF MATHEMATICS

Henry A. Converse, *Acting Head of Department.*

John H. Bramble,
Oliver Bacharach,
William H. Wilhelm,
Harvey S. Houskeeper,
Thomas F. Garey,
Joseph E. Hodgson.

DEPARTMENT OF SCIENCE.

William H. Hall, *Head of Department.*

Rowland Watts,
J. Edward Broadbelt,
Irving L. Twilley,
James B. Arthur,
Othello Schroedl.

DEPARTMENT OF ENGLISH AND MODERN LANGUAGES.

SAMUEL M. NORTH, *Head of Department.*

J. WARD WILLSON,
EDWARD REISLER,
ELMER M. HARN,
WILLIAM P. STEDMAN,
GEORGE S. WILLS.

DEPARTMENT OF HISTORY AND CIVICS

J. MONTGOMERY GAMBRILL, *Head of Department.*

ISAAC L. OTIS,
CHARLES F. RANFT,
PHILIP DOUGHERTY.

CALENDAR FOR SCHOOL YEAR, 1908-1909.

September 14, Monday	Opening of Session.
November 20, Friday	First Quarter ends.
November 23, Monday	Second Quarter begins.
November 26, Thursday	Thanksgiving Day.
December 23, Wednesday	Christmas Vacation begins.
January 4, Monday	Session resumed.
February 1, Monday	Semi-annual Examinations begin.
February 12, Friday	Second Quarter ends.
February 15, Monday	Third Quarter begins.
February 22, Monday	Washington's Birthday.
April 2, Friday	Third Quarter ends.
April 5, Monday	Fourth Quarter begins.
April ——	Arbor Day.
April 7, Wednesday	Easter Vacation begins.
April 13, Tuesday	Session resumed.
May 17, Monday	Annual Examinations begin.
June 15, Tuesday	Commencement Day.
September 13, Monday	Opening of Session.
November 19, Friday	First Quarter ends.
November 22, Monday	Second Quarter begins.
November 25, Thursday	Thanksgiving Day.
December 23, Thursday	Christmas Vacation begins.

COURSE OF STUDY AND GENERAL STATEMENT OF PLAN AND PURPOSE.

The course of study for the Baltimore Polytechnic Institute is designed to accomplish the following purposes:

1. To give a sound fundamental education to pupils whose inclinations and other circumstances preclude a college course.

2. To give to youth that healthful and highly valuable manual training which broadens education, and conduces to dexterity, contrivance, and invention.

To this end, the time usually devoted to Greek and Latin is employed, during two years of the course, in carpentry, sheet-metal, and light forge exercises. These exercises cover what are known as Manual Training, and are given with special reference to their educational value.

3. To give to students in the third and fourth years such studies in Engineering, Mathematics, Physics, and Chemistry, and such mechanical exercises in Applied Manual Training as will fit them:

(a) For immediate and remunerative employment in the wide field of civil, mechanical, and electrical engineering, where, it is believed, their training will lead to rapid advancement.

(b) For entrance to advanced standing into an institution of technology, should a higher technical education be desired.

For the attainment of these objects there is one carefully planned general course of study, no effort being made to specialize until the fourth year, by which time a student will have acquired a considerable degree of practical skill and intimate knowledge in some one of the professions based on mechanical art and applied science that he may have elected to follow. Thus, in the fourth year in the subject of Design, the student may select examples of mechanical, electrical, or civil engineering design, the amount of such practice being limited only by the capacity of the student and the time available. Extra opportunities in the laboratories are offered advanced students for more extended investigations than those demanded by the course.

No attempt is made to teach trades, but the equipment is of such nature that the instruction given in the shops is designed to be correlative to the work of the classroom, and results are aimed at that will insure success in mechanical pursuits subsequent to graduation. It is believed that instruction in correct methods of using tools, and practical illustrations of how, and for what purpose, things are done, are of more value than mere excellence in hand skill.

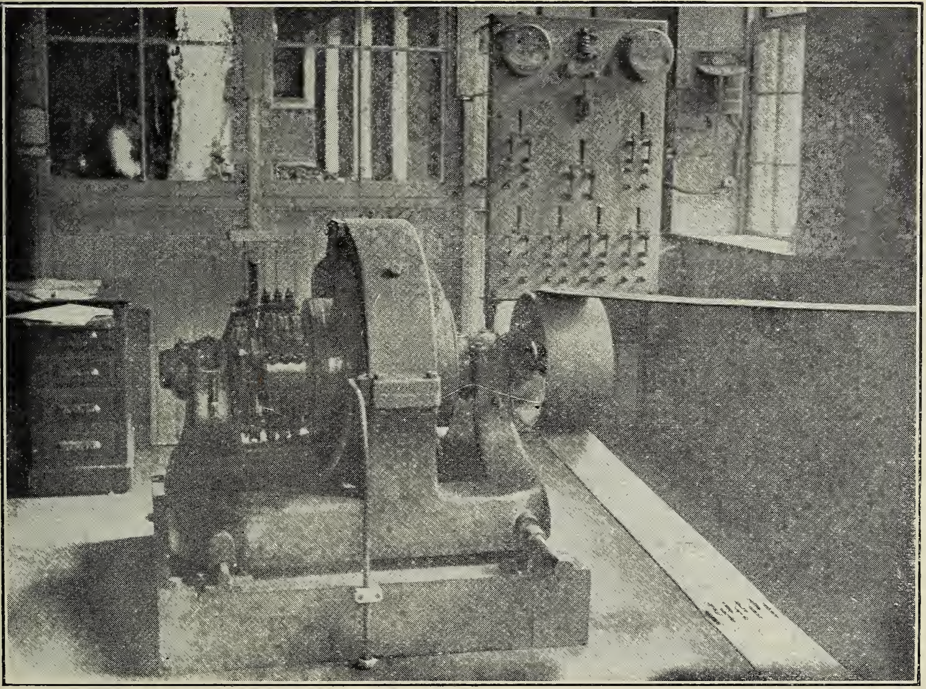
In the Department of English and Modern Languages, instruction in English is given during the first, second, and third years. The course comprises: (a) A review of grammar; (b) systematic study and practice in composition and rhetoric; and (c) reading and study of the works of representative British and American authors, including the college entrance requirements. The instruction in German during the second and third years, and in French during the fourth year, is designed to give a reading, rather than a speaking, knowledge of these languages, in order to meet entrance requirements of institutions of technology.

In the Department of History and Civics, instruction is given during the first and second years. The course includes about one-half the work prescribed by the Committee of Seven, the first year being devoted to English History, and the second year to American History and Civics.

In Mathematics, care is taken at the beginning of the first year to discover and correct any defects in fundamental training, after which the course of instruction proceeds in Algebra, Geometry, Trigonometry, Analytic Geometry, Descriptive Geometry, and the Differential and Integral Calculus, the completeness of the course enabling the graduate to read understandingly a treatise on any of the mechanical sciences.

In the Department of Science, the work of the first and second years in Physics embraces the properties of matter and elementary mechanics, the instruction being accompanied with lectures illustrated by experiments and with practical work in the laboratory. The instruction of third and fourth year students in this subject is confined to Heat and Electricity. The dynamic theory of heat, the conversion of heat into mechanical work, and the thermodynamics of the steam engine are the particular features of the fourth year in the study of Heat.

In Electricity, the work of the fourth year consists of practical applications of the theoretical study of the second and third years, and of commercial electricity. Electric lighting, both arc and incandescent, is discussed from constructive and economic standpoints, and the advantages of high tension distribution of electric power are demonstrated. The dynamo and motor are treated in detail—operating, designing, and winding being carefully considered. The experimental equipment for this work consists of a twenty-five kilowatt generator, built by the students; a one-half horsepower alternating current motor coupled to a twenty-five volt multipolar generator; and several small machines of various types. These appliances, with the electric light equipment of the Institute, present opportunities for the operation of electrical machinery and for the detection of defects and faults to be overcome. Alternating currents are treated both mathematically and experimentally, and converters, motors, impedance coils, and measuring instruments are used by students for verifying laws and descriptions given in lectures. The switchboard and the generator plant afford opportunities for power station practice, and the electric railway is treated in a practical manner. The newest and best methods of telegraph and telephone construction are presented, the telephones of the Institute being installed on the common battery plan.



DYNAMO AND SWITCHBOARD, MECHANICAL LABORATORY.

Special features of the course are the various tests for insulation resistance of conductors, the tests for grounds, faults and short circuits on lines, and the treatment of the defects in the dynamo and motor, and remedies therefor.

For the study of chemistry there are chemicals and apparatus in the laboratory to give to the third year students instruction concerning the nature and reactions of the chemical elements and their compounds, and to students of the fourth year a brief course in qualitative and quantitative analysis, the compounds formed in the various reactions and their chemical equations being particularly emphasized.

In the Department of Engineering, the instruction given the fourth year students in theoretical and applied mechanics embraces the laws of equilibrium and motion; centre of gravity; friction; principles of work; moment of inertia; mechanics of materials; graphic statics; and an elementary study of the stresses and deformations produced in standard specimens of metals when subjected to tension, compression, and shearing. The work of the third and fourth year students in steam engineering consists of the study of thermodynamics of the steam engine in a manner as comprehensive as the facilities of the Institute and the maturity of the students permit. Numerous calculations are made involving engine and boiler efficiencies and proportions, and the study of the indicator is supplemented with practice in taking diagrams, from which the consumption and distribution of the steam and the power of the engine are determined. The advantages and disadvantages of the different kinds of steam boilers are studied, particular attention being given to boiler attachments. The plant for this work consists of an inverted triple expansion engine of 100 I. H. P., an inverted compound engine of 60 I. H. P., a high-speed automatic cut-off engine (Harrisburg Standard) of 46 I. H. P., a horizontal power engine of 25 I. H. P., a Campbell & Zell sectional boiler (rated at 100 horse-power), and a Roberts' saftey water tube boiled capable of generating steam for the production of 120 I. H. P. when used in connection with the triple expansion engine. The engines mentioned above were built by the students, the first two after designs of the Bureau of Steam Engineering of the Navy Department, and there is now in course of construction by the students a four cylinder, 30 H. P., gasoline engine of the Autocar type. Grouped in the mechanical laboratory are all the engines, the 25 K. W. generator, the switchboard controlling the lighting installation of the Institute, a Riehle testing machine of 50,000 pounds capacity, and apparatus for calibrating pressure gauges, thermometers, and indicator springs. The compound and triple expansion engines may be worked singly or together in connection with a friction dynamometer specially designed at the Institute, an internal circulation of water in the brake wheel enabling the engine to run continuously in making power tests. The Roberts' boiler is installed in a room immediately connected with the laboratory, and furnishes steam at 150 pounds pressure per square inch for the stage expansion engines, and at 95 pounds and 40 pounds to the high-speed and power engines respectively, Foster regulators reducing the pressure as desired. Horizontal and vertical separators are placed in the steam pipes to insure the delivery of dry steam to the engines, and connections are made for calorimeter tests. The surface condenser used in connction with the stage expansion engines may also be connected with the exhaust of the high-speed engine when desired. The water from condensation is delivered to a filter of approved design by a Knowles independent air pump, and thence direct to the boiler either by a Knowles duplex pump or Pemberthy injector. Exhaustive engine and boiler tests for power and efficiency are made by squads of fifteen of the senior class, the results of which are recorded in standard forms and retained by the students.

In the mechanical drawing room are 175 tables of approved design, and an equipment of instruments and models well adapted to the requirements of an advanced course in the subject. Third year students are required to make a free-hand sketch of the parts of some machine, from which a finished drawing, tracing, and blue print are made. The work of the fourth year students in design tends to make them draftsmen in the true sense—not mere copyists.

The equipment in the machine, pattern, forge, sheet metal, and carpentry shops is equal to that of any similar institution in the country.

THE COURSE OF INSTRUCTION IN DETAIL.

The course extends over the usual period of ten months, but after deducting holidays and the time allowed for examinations, it is found that not more than thirty-two effective weeks remain for instruction.

Students completing the course as here outlined have invariably obtained full Sophomore standing with some Sophomore credits in the courses leading to the degrees of C. E., M. E and E. E. at Cornell and Lehigh Universities.

DEPARTMENT OF ENGINEERING AND APPLIED MECHANICS.

FIRST YEAR COURSE—D CLASS.

Mechanical Drawing.—32 weeks, 4 periods a week:

Use of instruments; lettering; elementary lessons.

Practice.—32 weeks, 4 periods a week:

(*a*) Carpentry; 16 weeks, 4 periods a week:

Lectures and exercises in laying out, cutting, framing, and joining wooden members.

(*b*) Sheet Metal; 16 weeks, 4 periods a week:

Lectures and exercises in soldering, and in sheet metal and venetian iron work.

SECOND YEAR COURSE—C CLASS.

Mechanical Drawing.—32 weeks, 5 periods a week:

Hatching; tinting; neatness and accuracy; scale drawing; intersection and development of surfaces.

Practice.—32 weeks, 4 periods a week:

(*a*) Carpentry; 4 weeks, 4 periods a week:

Review of the work of the first year.

(*b*) Pattern Making; 12 weeks, 4 periods a week:

Exercises in wood turning and in making simple patterns.

(*c*) Forge Work; 8 weeks, 4 periods a week:

Light forging and welding.

(*d*) Vise Work; 8 weeks, 4 periods a week:

Exercises in chipping and filing.

THIRD YEAR COURSE—B CLASS.

Steam Engineering.—32 weeks, 4 periods a week:

Types of boilers; boiler details; boiler room auxiliaries; the steam engine; engine details; indicating and governing; governors; valves; condensers; multiple expansion engines; properties of perfect gases; properties of saturated steam; use of steam tables; combustion of fuel and steam generation; boiler and engine efficiencies; the engine mechanism; slide valve and link motion.

Mechanical Drawing.—32 weeks, 4 periods a week:

Detail drawings of machines from free-hand sketches; the working drawing, tracing and blue print. Descriptive Geometry (see course in Mathematics).

Practice.—32 weeks, 4 periods a week:

(*a*) Patern Shop; 16 weeks, 4 periods a week:

Exercises in making patterns for wrenches, pullies, eccentrics, pillow-blocks, gears, globe valves, pipe joints, and core boxes where necessary. Lectures on construction and finish of patterns, and on the different kinds of molding, the mixing of iron and brass, and the operation of the cupola.

(*b*) Machine Shop; 14 weeks, 4 periods a week:

Casehardening, and work on the lathe, planer, milling machine, drill-press, and vise.

(*c*) Forge Shop; 2 weeks, 4 periods a week:

Forging and tempering machine cutting tools.

FOURTH YEAR COURSE—A CLASS.

The Steam Engine.—20 weeks, 3 periods a week:

The indicator and indicator diagram; measurement of power and of steam consumption; expansion of perfect gases and of steam; the ideal and actual engine; engine and boiler design; valve diagrams; engine and boiler testing; the steam turbine.

The Internal Combustion Engine.—12 weeks, 3 periods a week:

Gaseous fuels; oil engines; types of explosive engines; operation and management of the explosive engine.

Mechanics.—32 weeks, 5 periods a week:

First Principles: Matter; mass; inertia; velocity; acceleration; force; absolute measure of force; gravity; gravitation units of measure; comparison of gravitation and absolute measure of force.

Kinematics: Motion in a straight line with a constant acceleration; falling bodies; resolution and composition of velocities; the conversion of motion; harmonic notion; velocity ratios.

Dynamics.—(*a*) Statics: The parallelogram, triangle, and polygon of forces; composition and resolution of forces; conditions of equilibrium; transmissibility of force; parallel forces; moments of forces and of couples; conditions of equilibrium of a body under the action of three forces in one plane; centre of gravity; friction; virtual velocities; the mechanical powers. (*b*) Kinetics: The laws of motion; centripetal and centrifugal forces; kinetic energy, or *vis viva,* of a moving body; impulsive forces; direct and oblique collision of bodies; work.

Mechanics of Materials: Stress; strain; elastic limit; ultimate strength; bending and resisting moments; moment of inertia; radius of gyration; simple and cantilever beams; struts; deflection; torsion; resilience; bending-moment and shear diagrams.

Graphic Statics: The funicular polygon; the reciprocal diagram for determining stresses in framed structures.

Mechanics of Machinery: Transmission of power by means of belts and toothed gears; theory and action of pumps.

Mechanical Drawing and Design.—32 periods, 4 periods a week:

Mechanical Drawing: The drafting accompanying the work in design; free-hand sketches, working drawings, tracing, and blue prints.

Design: Proportioning of machine parts, such as spur, bevel, and worm gearing, belt pulleys, and bearings, from empirical and rational formulas. The application of the mechanics of materials to the design of some part of an engine or tool, such as cylinder, connecting rod, valve, screw jack. The use of the Zeuner diagram in valve design. The application of graphic statics to the design of a roof truss or bridge member. Students are permitted to select a subject for design from a list of mechanical and electrical devices submitted to them.

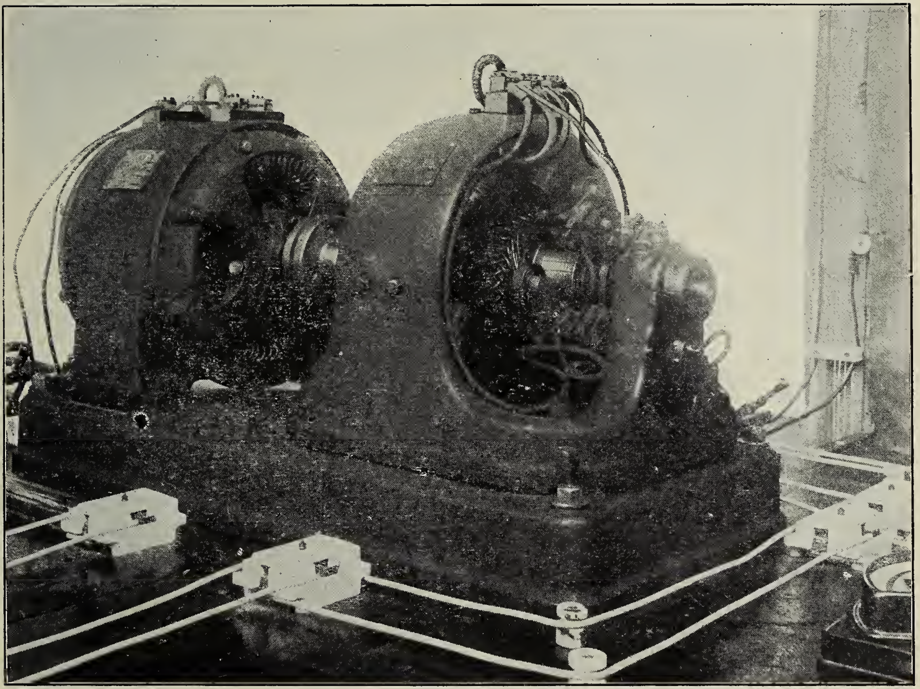
Practice.—32 weeks, 2 periods a week:

(*a*) Machine Shop; 16 weeks, 2 periods a week:

Machine work involving accuracy and finish, such as gear cutting, building and assembling of machinery.

(*b*) Engineering Laboratory; 16 weeks, 2 periods a week:

Tension, compression, and bending tests with a Riehle machine; calibration of pressure gauges, thermometers, and indicator springs; calorimeter tests for quality of steam; valve setting; determining clearance; duty of steam pumps; indicated steam consumption of engines; economy tests of engines and boilers.



WESTINGHOUSE MOTOR GENERATOR.

USED IN LABORATORY.

DEPARTMENT OF MATHEMATICS.

FIRST YEAR COURSE—D CLASS.

Algebra.—32 weeks, 4 periods a week:

Definitions and notation; fundamental operations; integral linear equations; factoring; highest common factor; least common multiple; fractions; fractional equations; simultaneous linear equations; graphical representation; inequalities; involution; evolution; theory of exponents; surds; quadratic equations.

Geometry.—32 weeks, 3 periods a week:

Geometry of the straight line and circle; proportion; properties of similar figures; original exercises.

Explanation and Demonstration.—32 weeks, 1 period a week:

The most difficult and important features of the course are explained and demonstrated.

SECOND YEAR COURSE—C CLASS.

Algebra.—32 weeks, 3 periods a week:

Review; theory of quadratic equations; variables and limits; indeterminate equations; ratio and proportion; logarithms; variation; arithmetical, geometrical, and harmonic progressions; binomial theorem; undetermined coefficients.

Geometry.—16 weeks, 3 periods a week, and 16 weeks, 2 periods a week:

Areas and volumes; lines and planes in space; polyhedrons; cylinder; cone; sphere; original exercises.

Trigonometry.—16 weeks, 2 periods a week:

Functions of the acute angle; the right triangle; use of tables; functions of any angle; relations between the functions of several angles; inverse trigonometric functions.

THIRD YEAR COURSE—B CLASS.

Trigonometry.—22 weeks, 3 periods a week:

General formulas; oblique triangle; miscellaneous examples.

Surveying.—10 weeks, 3 periods a week:

Instruments and their uses; land surveying.

Analytic Geometry.—32 weeks, 4 periods a week:

The straight line; circle; parabola; ellipse; hyperbola; transformation of coordinates; construction of loci; higher plane curves.

Descriptive Geometry.—Time taken from mechanical drawing, as it is taught in connection with that subject:

Projections; problems in straight line and plane; projections and sections of solids; curved surfaces and tangent planes; development and projection of screw thread; intersection of surfaces.

FOURTH YEAR COURSE—A CLASS

Differential and Integral Calculus.—32 weeks, 5 periods a week:

Differentiation of algebraic and transcendental functions; successive differentiation; expansion of functions, including the development of Maclaurin's and of Taylor's theorems; evaluation of indeterminate forms; mode of variation of functions of one variable, including geometric problems in maxima and minima; differentiation of functions of more than one variable; radius of curvature; tangents and normals; derivatives of arcs, areas, volumes, and surfaces of revolution; fundamental rules and methods of integration; geometrical applications of the calculus to lengths of curves, to areas, to volumes of solids of revolution; integration of trigonometric functions; successive integration; applications to mechanics.

DEPARTMENT OF SCIENCE.

FIRST YEAR COURSE—D CLASS.

General Physics.—32 weeks, 3 periods a week:

The subject is taught with reference to phenomena, mathematical calculations by the student not being required, though simple problems are explained by the instructor. Familiarity with scientific terms and the stimulation of interest in the subject are sought, one period a week being devoted to explanation and experimental demonstration by the instructor.

SECOND YEAR COURSE—C CLASS.

General Physics.—32 weeks, 3 periods a week:

The study of phenomena is continued, though more advanced. Derivation of formulae and the solution of problems are required. Experimental work by the instructor is quantitative rather than qualitative. Emphasis is laid upon such sections as have reference to various engineering courses. One period a week is devoted to individual work in the laboratory.

THIRD YEAR COURSE—B CLASS.

Electricity.—32 weeks, 3 periods a week:

Magnetism; galvanometers and other measuring instruments; laws of electrical action; magnetic and electrical units; simple alternating currents; derivation of formulae and practical problems; experimental demonstration by the instructor; individual laboratory work in electrical measurements.

Chemistry.—32 weeks, 2 periods a week:

Recitations in general chemistry with experimental work by the instructor, showing the preparation and reactions of various elements and compounds. One period a week is devoted to individual laboratory work.

FOURTH YEAR COURSE—A CLASS.

Electricity.—32 weeks, 4 periods a week:

Lectures and recitations in applied electricity, including electrochemical action; principles of the generator, motor, and transformer; railways; line and machine testing; telegraph and telephone; electric lighting. One period a week is devoted to individual laboratory work in measurements, practical testing, and the operation of the generator, motor, and transformer.

Chemistry.—32 weeks, 4 periods a week:

Theory of analysis; qualitative analysis of solutions and powders; quantitative analysis of solutions containing silver, ammonia, mercury, and iron, by volumetric method; quantitative analysis of solutions for barium and phosphoric acid, by gravimetric method; simple determinations of carbon, sulphur, manganese, and silicon in iron and steel. Students who are preparing for universities requiring more time in elementary chemistry, are allowed to substitute the study of general chemistry for the above analytic course.

DEPARTMENT OF ENGLISH AND MODERN LANGUAGES.

FIRST YEAR COURSE—D CLASS.

Review of English Grammar.—16 weeks, 2 periods a week:

Composition and Rhetoric.—32 weeks, 2 periods a week:

Study of text and frequent written exercises based upon Narration and Description; letter writing.

Literature.—32 weeks, 3 periods a week:

(*a*) Study of the following selections: Sketch Book; Snow Bound; Tales of the White Hills; Poems and Tales from Poe; Sir Launfal; Lays of Ancient Rome; Lady of the Lake; Ivanhoe.

(*b*) Leading facts in the lives of the authors represented in (*a*).

SECOND YEAR COURSE—C CLASS.

Composition and Rhetoric.—32 weeks, 2 periods a week:

Frequent written exercises; study of rhetorical principles.

Literature.—16 weeks, 3 periods a week; and 16 weeks, 2 periods a week:

(*a*) Study of the following selections: Ancient Mariner; Vicar of Wakefield; Deserted Village; Silas Marner; De Coverley Papers; Merchant of Venice; Palgrave (in part).

(*b*) Leading facts in the lives of the authors represented in (*a*).

German.—32 weeks, 3 periods a week:

Study of the grammar and reading.

THIRD YEAR COURSE—B CLASS.

Literature and Composition.—32 weeks, 3 periods a week:

Study of the following texts: Julius Caesar; Macbeth; Milton's L'Alegro, Il Penseroso, Lycidas, and Comus; Washington's Farewell Address; Webster's First Bunker Hill Oration, or Burke's Speech on Conciliation. Frequent written exercises.

German.—32 weeks, 3 periods a week:

Composition; grammar; reading standard German fiction and simple scientific prose.

FOURTH YEAR COURSE—A CLASS.

French.—32 weeks, 3 periods a week:

Study of grammar; composition; reading simple literary and scientific prose.

DEPARTMENT OF HISTORY AND CIVICS.

FIRST YEAR COURSE—D CLASS.

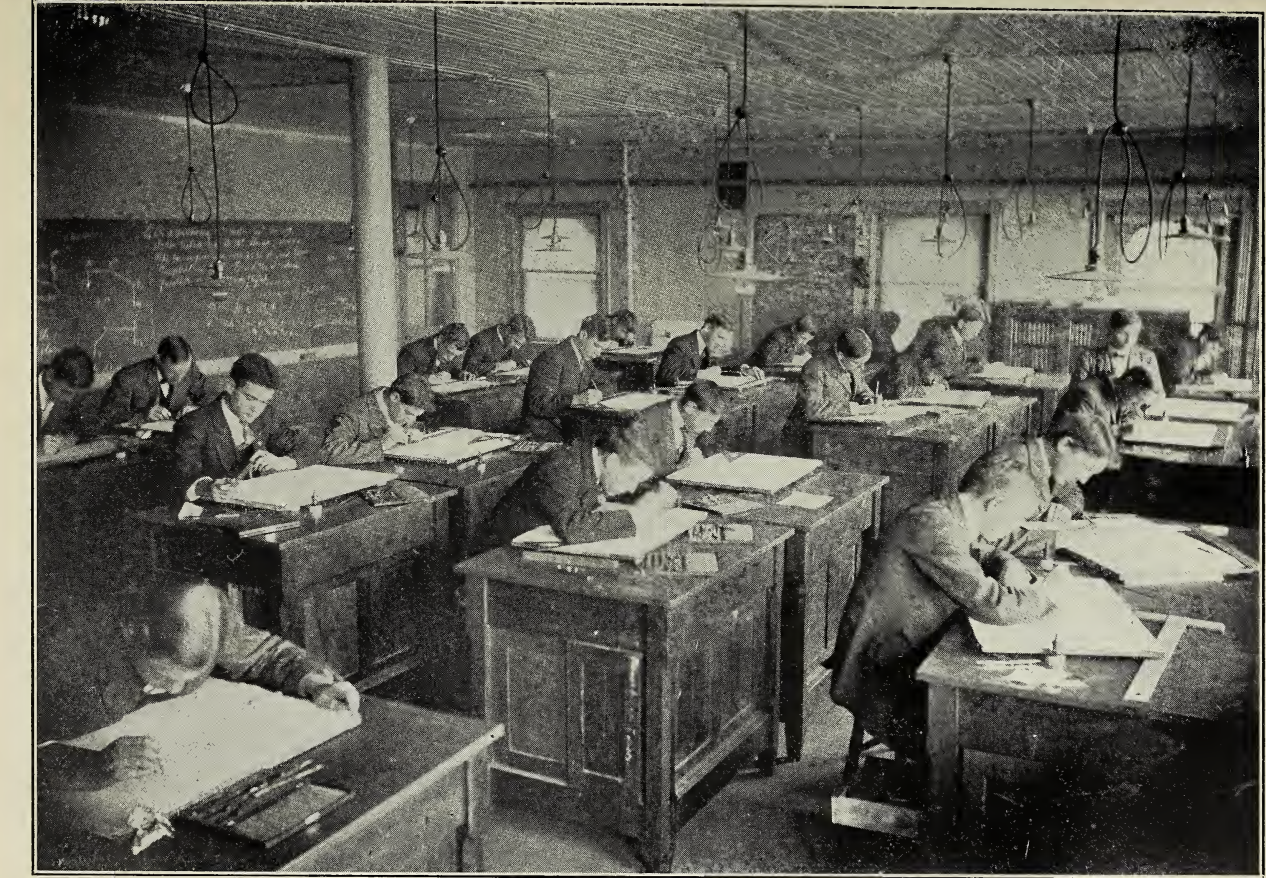
History.—32 weeks, 5 periods a week:

English History from its beginnings to the present day. Especial attention is given to the social, economic, and political phases of the subject; and as far as time and the maturity of the pupils permit, attention is directed to the development of Europe as it progressed contemporaneously with England.

SECOND YEAR COURSE—C CLASS.

History and Civics.—32 weeks, 4 periods a week:

American History, with special attention to political development; civil government of the United States and the rights and duties of American citizenship.



SENIOR CLASS, MACHINE DESIGN

TIME DEVOTED TO THE DIFFERENT SUBJECTS COMPRISING THE FOUR YEAR COURSE.

	NUMBER OF HOURS PER YEAR.				
	1st Year.	2nd Year.	3rd Year.	4th Year.	Aggregate.
DEPARTMENT OF ENGINEERING.					
Carpentry	64	16	......	......	80
Sheet Metal	64	......	......	......	64
Vise	......	32	..	......	32
Forge	......	32	20	......	52
Pattern	......	48	64	......	112
Machine	......	......	44	32	76
Mechanical Laboratory	......	......	......	32	32
Mechanical Drawing	128	160	96	......	384
Descriptive Geometry	......	......	32	......	32
Machine Design	......	......	......	128	128
Steam Engineering	......	......	128	96	224
Mechanics	......	......	......	80	80
Mechanics of Materials	.....	......	......	80	80
DEPARTMENT OF MATHEMATICS.					
Algebra	128	96	......	......	224
Geometry	128	80	......	......	208
Geometry, Analytic	......	......	128	......	128
Trigonometry	......	32	66	......	98
Surveying	......	......	30	......	30
Calculus, Differential	......	......	......	80	80
Calculus, Integral	......	......	......	80	80
DEPARTMENT OF SCIENCE.					
Physics	96	64	......	......	160
Physics, Laboratory	......	32	......	......	32
Electricity	......	......	64	96	160
Electricity, Laboratory	......	......	32	32	64
Chemistry, Elementary	......	......	32	*96	32
Chemistry, Laboratory	......	......	32	*32	32
Chemistry, Analytic	......	......	......	128	128
DEPARTMENT OF ENGLISH.					
English Grammar	32	......	......	.....	32
Composition and Rhetoric	64	64	......	......	128
Literature	96	80	96	......	272
German	......	96	96	......	192
French	......	......	......	96	96
DEPARTMENT OF HISTORY AND CIVICS.					
History	160	.	......	......	160
History and Civics	......	128	......	......	128
Totals	960	960	960	960	3840

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*Students preparing for the universities receive instruction in Elementary instead of Analytic Chemistry.

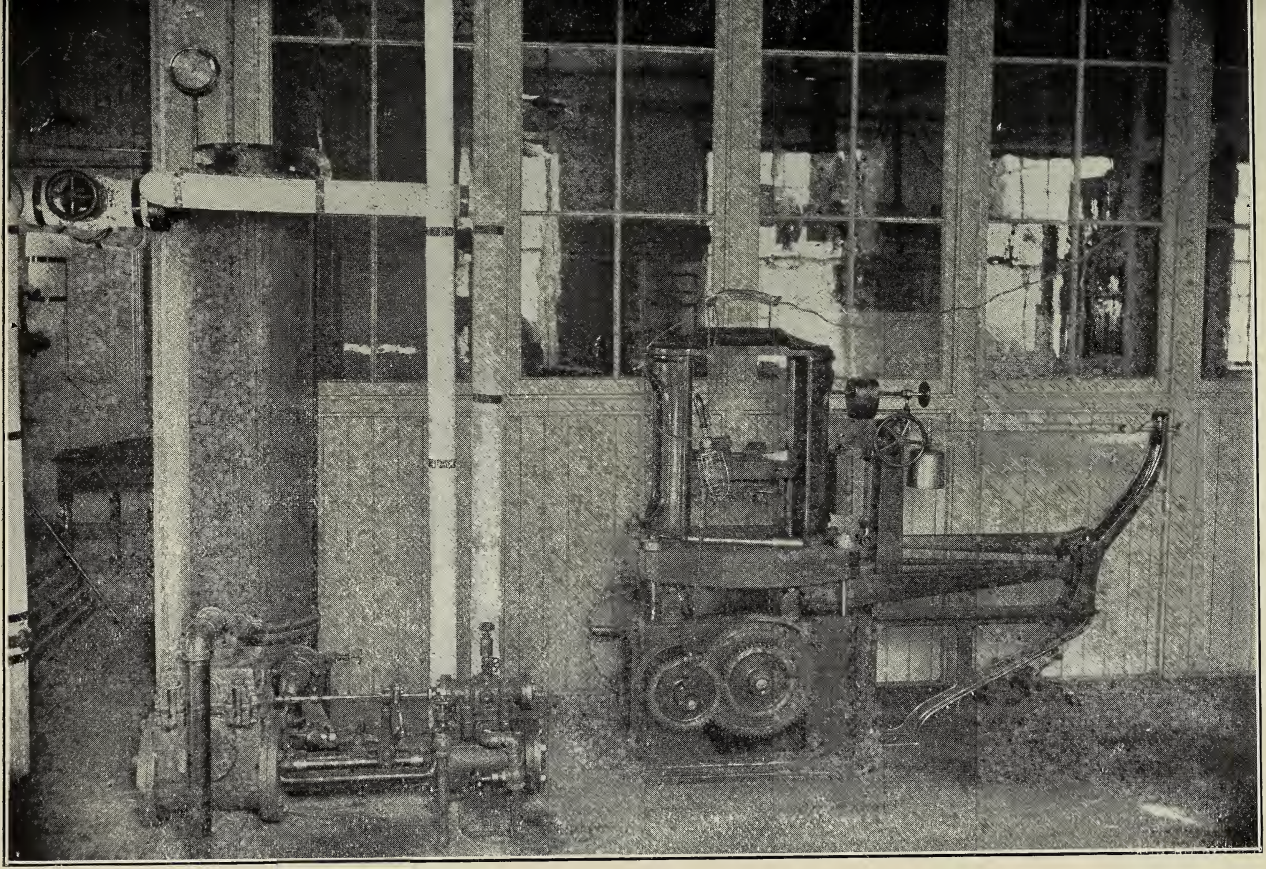
REQUIREMENTS FOR ADMISSION.

Pupils bearing properly attested certificates of having passed the prescribed Grammar School Course of the Public School System of Baltimore are entitled to enrollment.

Other applicants residing in the city will be admitted after passing an examination covering the requirements of the eighth grammar school grade. Eighth grade grammar school pupils who fail of promotion are not eligible for admission under this requirement. Specimen entrance examination papers covering the requirements of the eighth grade will be found on pages 58, 59 and 60.

Non-resident applicants, in addition to passing the entrance examination, are required to pay an annual fee of $72.00, charged for tuition and for the use of books.

After having successfully passed the entrance examination, a non-resident applicant must register as such at the office of the Secretary of the Board of School Commissioners, where he will be furnished with a bill for the first quarterly installment of the fee, and a presentation at the Institute of a coupon from the bill, signed by the City Comptroller, will be accepted as evidence of payment, and entitle the applicant to enrollment.



CONDENSER AND RIEHLE TESTING MACHINE, MECHANICAL LABORATORY

MERIT ROLLS.

Merit rolls, showing the proficiency of students in each branch of study, are made out annually for the different classes.

Each subject is assigned a coefficient indicative of its relative weight, and the final mark of a student in a subject (on a scale of 100) is multiplied by its coefficient. The sum of the products thus obtained is the final mark of the student in all the subjects for the year. This mark is a certain percentage of the sum of the cofficients, and such percentage is the student's average for the year.

BALTIMORE POLYTECHNIC INSTITUTE.

FINAL MERIT ROLL AND FOURTH YEAR RECORD OF GRADUATING CLASS OF 1908.

Order of Merit.	NAMES.	Date of Admission.	Mechanics.	Mechanics of Materials.	Steam Engineering.	Mech. Drawing and Design.	Diff. and Integral Calculus.	Chemistry.	Applied Electricity.	French.	Practice.	Deportment.	Aggregate for 1st Year.	Aggregate for 2nd Year.	Aggregate for 3rd Year.	Aggregate for 4th Year.	Aggregate for Four Years.	Graduating Average.
	MAXIMA		7	10	10	8	10	10	10	5	5	5	20	40	60	80	200	100
40	O. E. Adams	1904	5.32	7.80	7.60	7.12	8.10	7.60	7.80	3.70	4.15	4.50	15.93	31.11	48.78	63.69	159.51	79.76
25	G. H. Armstrong	1904	5.74	7.70	8.00	6.64	8.10	8.10	8.60	4.30	4.10	3.90	18.36	34.86	49.92	65.18	168.32	84.16
45	C. P. Bolgiano	1904	5.18	8.10	7.10	7.20	7.50	7.20	7.90	3.85	4.20	4.20	16.98	32.53	45.66	62.43	157.60	78.80
41	G. F. Bolgiano	1904	5.74	8.10	7.60	6.80	7.60	7.80	8.70	4.15	4.15	4.50	15.40	32.24	46.66	65.14	159.44	79.72
⁂6	E. B. Bryan	1905	5.60	8.20	7.90	6.96	8.50	7.30	8.10	4.45	4.40	5.00	16.85	34.50	50.76	66.41	178.52	89.26
51	J. D. Bullock	1904	5.81	7.40	7.60	6.16	6.60	7.80	7.60	4.05	3.75	2.90	16.52	31.58	47.54	59.67	155.31	77.66
††55	N. R. Butler	1904	5.95	6.70	8.10	6.16	8.20	8.60	9.00	4.55	4.35	4.95	17.96	36.22	54.04	66.56	174.78	87.39
42	W. S. Byrne	1904	5.74	7.50	7.30	6.32	8.00	8.10	8.10	4.20	3.80	3.10	17.02	32.84	47.08	62.16	159.10	79.55
*19	J. R. Carroll, Jr.	1904	6.16	8.30	8.30	7.04	9.20	8.60	8.60	4.30	4.45	5.00	17.03	33.82	50.22	69.95	171.02	85.51
34	T. D. Conn	1904	5.18	7.20	7.80	6.88	7.90	7.60	8.00	4.00	4.15	4.50	17.09	33.42	48.88	63.21	162.60	81.30
54	P. Davenport	1903	5.32	7.70	7.70	6.96	7.70	8.30	8.30	3.95	3.65	3.25	15.29	30.73	44.10	62.83	152.95	76.48
*3	F. Davis	1904	6.65	9.60	9.50	7.76	9.60	8.50	9.20	4.75	4.45	5.00	17.47	34.52	54.08	75.01	181.08	90.54
48	A. Diaz	1904	6.09	7.10	7.30	6.80	8.20	8.40	7.40	4.45	3.90	4.25	15.70	30.82	45.48	63.89	155.89	77.95

BALTIMORE POLYTECHNIC INSTITUTE.

Final Merit Roll and Fourth Year Record of Graduating Class of 1908.

Order of Merit.	NAMES.	Date of Admission.	Mechanics.	Mechanics of Materials.	Steam Engineering.	Mech. Drawing and Design,	Diff. and Integral Calculus.	Chemistry.	Applied Electricity.	French.	Practice.	Deportment.	Aggregate for 1st Year.	Aggregate for 2nd Year.	Aggregate for 3rd Year.	Aggregate for 4th Year.	Aggregate for Four Years.	Graduating Average.
	MAXIMA		**7**	**10**	**10**	**8**	**10**	**10**	**10**	**5**	**5**	**5**	**20**	**40**	**60**	**80**	**200**	**100**
*7	A. Gailey	1904	6.23	8.40	8.80	7.60	9.30	8.70	8.40	4.50	4.55	5.00	17.34	34.54	53.62	71.48	176.98	88.99
44	F. Goldenberg	1904	5.81	7.20	7.50	6.24	7.50	7.80	7.90	4.00	3.90	4.90	16.20	32.21	46.66	62.75	157.82	78.91
21	E. E. Graham	1904	6.09	8.40	7.10	7.12	8.20	8.80	7.90	4.50	4.25	5.00	16.95	33.34	51.68	67.36	169.33	84.67
29	T. D. Gresham	1904	5.67	7.10	7.70	7.12	7.90	8.50	8.30	4.60	4.40	4.00	16.23	34.66	48.90	65.29	167.15	83.58
22	R. M. Hall	1903	5.18	7.50	8.70	7.44	8.50	8.10	8.30	4.20	4.25	5.00	16.89	35.33	49.92	67.17	169.31	84.66
39	W. L. Heathcote	1904	5.32	7.50	7.20	6.32	8.30	7.30	7.40	3.85	3.75	4.45	16.26	33.79	48.76	61.39	160.20	80.10
*17	W. F. Heiss	1904	6.16	8.60	8.60	7.28	9.50	8.10	8.90	4.05	4.30	5.00	18.16	34.86	49.32	70.49	172.83	86.42
36	H. C. Hess	1904	5.95	8.60	7.80	6.48	8.00	8.10	7.70	3.80	4.25	4.50	15.83	33.22	48.22	65.18	162.45	81.23
35	H. W. Hill	1904	6.09	7.30	8.20	6.56	7.20	7.60	7.70	4.55	4.35	4.50	17.00	33.20	48.34	64.05	162.59	81.30
*5	M. A. Hodes	1904	6.37	8.80	8.60	7.12	9.40	9.20	8.60	4.60	4.35	5.00	18.61	36.19	53.28	72.04	180.12	90.06
23	A. A. Hollander	1904	6.02	7.50	8.30	6.88	8.90	8.50	8.50	4.20	4.00	4.85	17.20	33.89	50.22	67.65	168.96	84.48
*9	H. J. Horn	1903	6.44	8.10	9.00	7.52	9.30	8.90	8.30	4.60	4.35	5.00	17.32	34.69	52.00	71.51	175.52	87.76
*12	R. H. Hoskins	1904	5.88	7.90	8.20	7.36	9.30	9.10	8.00	3.80	4.10	5.00	17.58	34.79	51.88	68.64	174.89	87.45

BALTIMORE POLYTECHNIC INSTITUTE.

FINAL MERIT ROLL AND FOURTH YEAR RECORD OF GRADUATING CLASS OF 1908.

Order of Merit.	NAMES.	Date of Admission.	Mechanics.	Mechanics of Materials.	Steam Engineering.	Mech. Drawing and Design.	Diff. and Integral Calculus.	Chemistry.	Applied Electricity.	French.	Practice.	Deportment.	Aggregate for 1st Year.	Aggregate for 2nd Year.	Aggregate for 3rd Year.	Aggregate for 4th Year.	Aggregate for Four Years.	Graduating Average.
	MAXIMA		**7**	**10**	**10**	**8**	**10**	**10**	**10**	**5**	**5**	**5**	**20**	**40**	**60**	**80**	**200**	**100**
***10**	H. A. Israel	1904	6.02	8.70	8.90	7.36	9.30	9.00	7.90	4.40	4.45	5.00	17.24	33.27	53.90	71.03	175.44	87.72
***‡‡4**	W. C. Jackson	1904	6.72	9.50	9.10	7.36	9.40	9.60	9.70	4.30	4.60	5.00	17.28	35.41	52.28	75.28	180.25	90.13
53	M. Janer	1904	5.32	7.30	7.00	6.72	7.70	7.90	7.40	4.55	3.75	4.00	16.02	30.77	45.66	61.64	154.09	77.05
46	C. R. Justi	1904	5.53	7.60	6.80	7.12	7.00	7.60	7.70	3.50	3.75	4.25	15.94	32.11	46.60	60.85	156.50	78.25
38	L. A. Kahn	1903	5.25	7.90	8.20	7.04	8.10	8.40	8.40	4.55	4.00	4.70	16.53	32.83	45.98	66.54	161.88	80.94
***1**	W. E. Lee	1904	6.44	8.60	9.50	7.68	9.40	9.20	8.60	4.50	4.80	5.00	17.53	36.30	54.20	73.72	181.74	90.87
43	A. H. Lemmon	1904	5.53	8.30	8.00	6.56	7.50	7.50	7.70	3.70	4.20	4.50	16.66	32.26	45.84	63.49	158.25	79.13
***13**	F. W. Lieberknech	1904	6.23	8.30	8.80	7.12	8.90	8.90	9.00	4.05	4.55	5.00	16.56	35.14	51.76	70.85	174.31	87.16
27	T. N. Manning	1904	5.88	8.10	7.20	7.20	7.70	9.00	8.30	4.05	4.50	5.00	16.38	33.31	50.80	66.93	167.42	83.71
31	R. C. Meyer	1903	5.60	7.90	8.80	7.20	7.60	8.10	8.40	3.85	4.30	5.00	15.56	31.61	51.56	66.75	165.48	82.74
†56	R. E. Palle	1904	5.04	6.00	7.20	6.88	6.70	7.90	7.20	4.10	3.90	3.75	15.14	32.89	45.96	58.67	152.66	76.33
***11**	M. W. Price	1904	6.23	8.60	7.70	7.36	9.00	8.50	8.60	4.20	4.40	5.00	17.46	35.68	52.56	69.59	175.29	87.65
52	J. P. Ray	1904	5.46	7.00	7.30	6.32	7.60	7.90	7.90	4.30	3.75	3.75	16.55	31.56	45.52	61.28	154.91	77.46

BALTIMORE POLYTECHNIC INSTITUTE.

FINAL MERIT ROLL AND FOURTH YEAR RECORD OF GRADUATING CLASS OF 1908.

Order of Merit.	NAMES.	Date of Admission.	Mechanics.	Mechanics of Materials.	Steam Engineering.	Mech. Drawing and Design.	Diff. and Integral Calculus.	Chemistry.	Applied Electricity.	French.	Practice.	Deportment.	Aggregate for 1st Year.	Aggregate for 2nd Year.	Aggregate for 3rd Year.	Aggregate for 4th Year.	Aggregate for Four Years.	Graduating Average.
	MAXIMA		7	10	10	8	10	10	10	5	5	5	20	40	60	80	200	100
49	N. G. Reinicker	1904	5.60	7.70	7.50	6.80	7.60	7.40	7.20	3.45	3.90	3.50	16.19	32.37	46.14	60.65	155.35	77.68
30	H. B. Reynolds	1904	6.30	8.10	9.00	6.88	8.20	7.90	9.10	3.55	4.15	4.40	17.03	32.98	48.62	67.58	166.21	83.11
47	N. F. Rigor	1904	5.67	7.30	7.40	6.24	7.30	7.00	7.90	3.95	4.35	4.45	16.63	32.56	45.80	61.56	156.55	78.28
32	E. Rolker	1903	5.53	7.50	7.90	7.04	8.60	7.60	8.30	3.25	4.10	5.00	15.39	34.04	49.64	64.82	163.89	81.95
50	R. Schlegel	1904	5.11	8.30	7.50	6.08	6.60	7.40	7.40	3.60	3.90	4.50	17.31	33.94	43.58	60.39	155.22	77.61
*2	C. Schluderberg	1904	6.30	7.80	8.50	7.28	8.50	8.70	8.50	3.85	4.25	4.75	17.14	34.08	50.98	68.43	170.63	85.32
*8	O. Schroedl	1904	6.23	8.70	8.80	7.36	9.00	9.10	8.90	3.70	4.40	5.00	17.94	34.70	52.16	71.19	175.99	88.00
*2	A. G. Schuster	1904	6.37	8.70	9.20	7.20	9.10	9.10	8.60	4.65	4.25	5.00	18.37	36.35	54.52	72.17	181.41	90.71
26	O. Sima	1904	6.02	8.00	8.30	7.12	9.10	8.50	8.20	3.90	4.50	5.00	16.62	33.65	49.30	68.64	168.21	84.15
37	B. F. Starr, Jr.	1904	5.88	6.80	7.40	7.04	7.80	7.70	8.20	3.80	4.25	4.45	16.85	33.48	48.40	63.32	162.05	81.03
28	M. D. Swartz	1904	5.15	8.80	8.00	7.04	9.00	8.70	8.20	4.00	4.15	4.50	17.12	33.82	48.92	67.54	167.40	83.70
*14	W. M. Troll	1904	6.02	8.50	8.60	7.04	9.20	9.30	9.20	3.80	4.30	3.40	18.02	35.52	51.10	69.36	174.00	87.00
*18	H. Vogt	1904	6.02	9.10	9.10	7.04	9.40	9.30	9.20	4.45	4.35	5.00	15.72	31.30	51.88	72.96	171.87	85.94
33	R. G. Waltenberg	1904	5 67	8.00	8.00	7.12	8.40	8.70	8.10	4.35	3.95	5.00	15.83	31.02	48.92	67.29	163.06	81.53
*16	C. C. S. Walter	1904	5.74	8.10	8.30	6.96	9.20	9.40	8.40	4.10	4.25	5.00	17.31	34.41	51.86	69.45	173.03	86.52
*‡15	L. C. Wright	1906	6 16	8.40	8.20	7.28	8.60	8.50	8.40	4.20	4.55	5.00	17.39	34.78	52.44	69.29	173.90	86.95
24	F. A. Zscheusler	1904	5.81	7.70	7.80	6.96	9.50	9.20	8 40	3.85	4.30	5.00	17.26	33.33	49.48	68.52	168.59	84.30

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* Received 85% or more of the aggregate multiple for the entire course.

† Deficient in Mechanics of Materials; allowed a re-examination in September and passed.

†† Diploma awarded at a later date.

‡ Graduated with credit in June, 1900, the course at that time being quite inferior to the present one.
Re-entered in September, 1906. and was enrolled in 3rd year class.

‡‡ Original entry, 1902; withdrew June 1903; re-entered in 2nd year class in 1904.

** Entered 2nd year class from Washington College, September, 1905.

ADDRESS

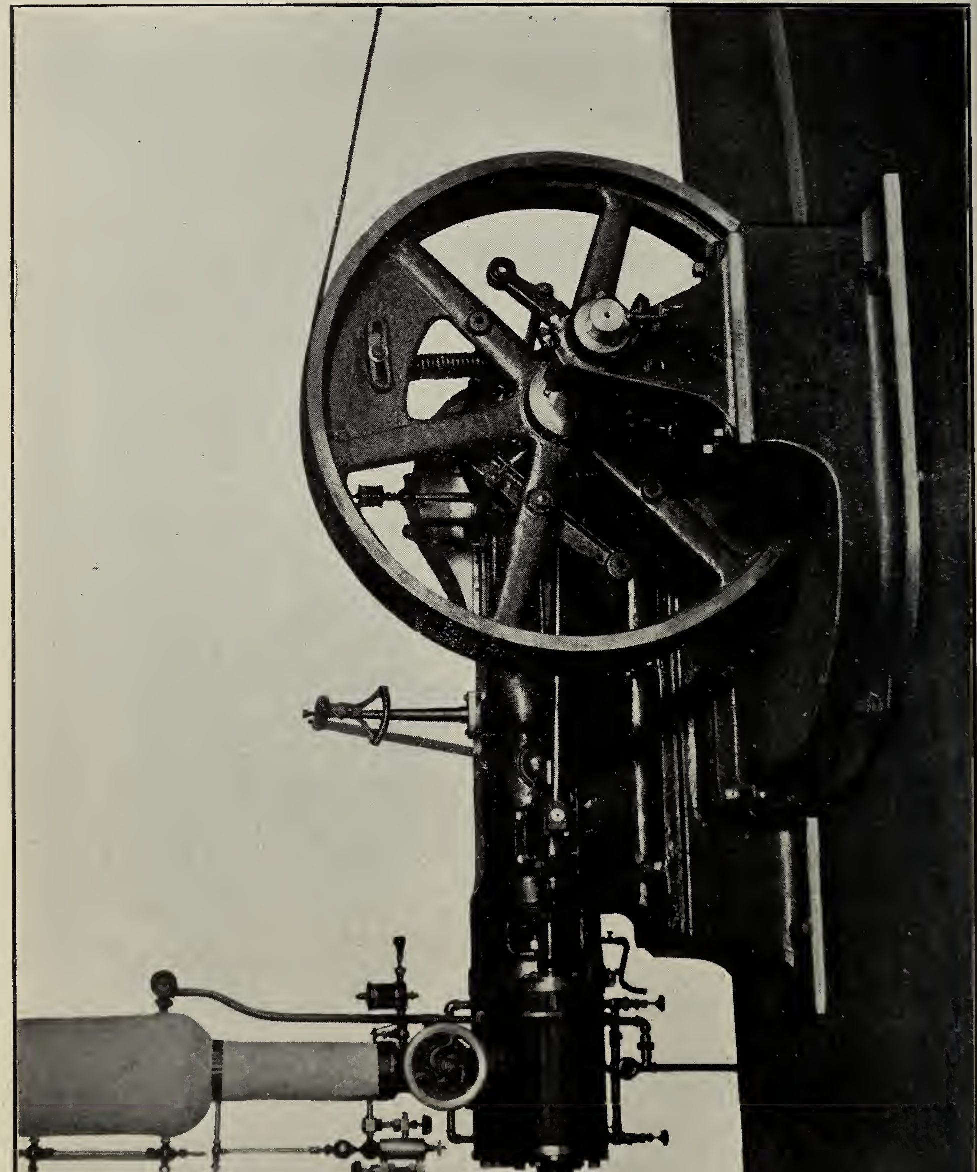
To the Graduating Class of the Baltimore Polytechnic Institute, by CHARLES MORRIS HOWARD, ESQ.

When I received the courteous invitation from Dr. Rosenau to make this address the letter in which it was couched contained these very significant words: "The address need not occupy more than twenty to thirty minutes." I do not know whether this significant circumstance had more influence upon the board when it decided to send me the invitation or upon me when I accepted it. Shortly afterwards, in conversation with Lieutenant King, I told him that I thought an address from me of fifteen or twenty minutes would be abundant in point of time, if insufficient in other particulars, and he said that the great aim of the Polytechnic Commencements was to get the whole thing over in forty-five minutes so that every one might get away and get out into the fresh air. I suppose by this he meant cold air as contra distinguished from oratory. I subsequently learned that there was to be a banquet at the Hotel Stafford immediately after these exercises and that some members of the class feared that I might keep them here while the dishes were spoiling.

Under these circumstances I have it in my power to make this speech a brilliant, if unexpected, success by taking my seat immediately. Without doing this I shall endeavor to be guided by that excellent old maxim "pauca verba." But I would remind you that it is not easy to make a brief speech. It is much easier to say *"parvum in multo"* than *"multum in parvo."*. More labor goes into a short speech than a long one. It has been said "in order to make a speech short, one must think long." The last I have not had the opportunity to do in this instance.

There are many reflections which present themselves as appropriate for development in talking to a class of young men at this important landmark in their careers, but I shall content myself with touching upon one or two.

You young men are going out from a school where you have had the advantage of a good fundamental and technical education in certain branches. You have been trained in the use of certain books and skilled in the use of certain tools and scientific methods. Let us hope that what you have acquired you have acquired with thoroughness and that you have been trained to love investigation and have a desire for further knowledge. Let us hope that you are impressed with the unlimited extent of the world of knowledge that remains to be discovered and with the comparative littleness of what you have already made your own. Let us hope that you will be in love with your profession, whatever particular branch you may elect to pursue.



your daily work in a workmanlike way; but I think you will be making a mistake if you devote every moment of your time to strictly professional work. This makes for a narrow career at best, possibly a short one with a nervous breakdown at the other end.

You will be confronted with difficulties and temptations when you get out into the world from which you were in a great measure shielded while at the college; among others laziness, want of system and the various forms of dissipation. If you fail to do a full day's work as you have understood that term, there will be no Lieutenant King to give you a bad mark and arouse your activities with his portentous frown. If you become disorderly and slouchy in your business habits, there will be no one to admonish you and brace you up. If you loaf on the street corners and smoke cigarettes, you will not be molested unless you get into the hands of the police; but your minds will deteriorate none the less. So they will if you acquire a taste for semi-weekly or even weekly vaudeville or those forms of dramatic fun and frolic that are frequently furnished on the other side of Jones' Falls and sometimes on this side. In other words each of you is about to become his own master which adds on one responsibility while not taking any away. You still have the duties of industry, steadiness and fidelity to ideals and the additional duty of seeing that these duties are performed. Discipline of some kind is essential to every well-regulated human life and when outside discipline leaves off, self-discipline should begin. Your formal education is drawing to a close, but the real education of life is just beginning. The next few years perhaps will determine whether you are able to go forward without the assistance of leading strings. From now on the test will be not so much success in recitations and examinations as in will power and force of character.

It is necessary that you should work hard, but it does not follow that your work should be entirely selfish. Get into your minds early that you owe ethical obligations to others, that the aim of life is not to acquire property or reputation but knowledge and character. Do not deem it smart to get ahead of other people and do not care very much whether people call you smart or the reverse. There are already too many smart people in the world. Cultivate ideals side by side with the activities of every-day life and broaden yourself by having, if you choose to call it so, a hobby or fad, which will take you away from business routine. It matters not whether it be history, or political economy. No form of culture is more broadening than historical science or more fascinating. Let it be English literature, if you prefer, or art or a foreign language. I assume that if you are following engineering or any other scientific profession you will endeavor to master its technical problems so as to earn your daily bread and do

There are several ways of staving off the decay of the faculties which is apt to arrive sooner or later. One is by rational physical exercise and another is by cultivating some outside intellectual interest which will broaden your faculties and rest you from your labors. We have recently heard too much I think of the gospel of strenuousness. We need a little more of the gospel of equipoise. If action is to be useful and productive, it should be preceded by sound and earnest thinking. Did it not seem Eutopian, I would suggest that these things might even go forward together. Whether the men who do things are the only people entitled to be canonized depends in some measure on what they do and how they are doing it.

You are about to enter upon careers in a life that is intensely practical. This strenuous life can be modified, broadened and I think sweetened, if you can imbue yourselves with some of what are known as the liberalizing arts. They will prove a useful antidote to your severe professional studies. It is said of the late William T. Walters that at an early age he realized the necessity of mastering something that was better and bigger than the business which was to bring him his great fortune. Consequently he devoted his spare hours to an appreciation of the fine arts. What was the result? His real contribution to his own happiness and that of thousands of his countrymen was not the rearing of a huge fortune but of that collection, now housed on Washington Square, which is not only a source of delight but of education and cultivation to thousands, and constitutes a monument to the man's life.

Therefore I say to each one of you, "endeavor to make yourself master of something other than trade or accumulation." These should rightly be a means to an end rather than end in itself. Whether it be history, art, English literature or some other tongue, ancient or modern, or some other avocation, seize upon it, appropriate it to yourself and make it your strong fortress against the slings and arrows of this life's fortune. And if you have the energy and ability to do this successfully, you will also have the energy and ability to make yourselves a successful place in the world of practical workers. Certainly a deep and real acquaintance with the English language and English literature cannot fail to be of the utmost practical value to an engineer, as was well pointed out in a recent issue of the Engineering Digest. In addition and much more important, it will be to you a source of unfailing delight and fortify you against some of the cheap and yellow tendencies of this present age.

I may perhaps be allowed one further word of advice, as it is customary to cast these commencement addresses into a somewhat sermonizing form, and this relates to your duty to the State. None of you can escape this, even though you should ignore it. It is your duty to inform yourself as to public affairs in any community where you may live and do what you can to better the conditions. No matter on how high a plane the condition of public affairs may be at any particular time and place, there is always a chance to make them better and more efficient. Every citizen bears the burdens of bad government and shares the blessings of good government. Who is to lift the plane of citizenship if not the citizen? The success of our government is the most important thing which has to do with us on this planet. Do not then make the mistake of thinking that you have nothing to do with it.

Speaking broadly, the government of American cities has been a failure, possibly the most conspicuous failure in America's governmental experiment. There are signs of improvement and all our cities are not alike. Baltimore is now on a high plane as to honesty and efficiency, but it would be quite absurd to claim that it cannot be improved. It is your duty to do something actively and definitely to keep it up to its present standard and make it go forward. You will be in a position to do this if you are to live here. You may think that you cannot, but you can. You have a good general education and special technical training. You can show a general interest in public affairs not simply by voting for the best men and measures but by joining some civic or neighborhood organization which is working for public improvements and by taking an active interest in its affairs. You can go further by informing yourself specially as to certain public questions and helping to mould public opinion and thus hasten improvements. You can always throw your weight in favor of a right and cleanly conduct of public affairs. Most of our public officials under the present municipal regime desire the city's progress and will welcome your co-operation in any forward movement, if that co-operation is intelligent and informing. I notice that your course of instruction included lectures in politics and civics. This is entirely appropriate and quite as important as knowing how to build an engine. The relation between physics and politics has been pointed out by Mr. Walter Bagehot and you have no doubt learned that the analogy between political and other kinds of machines is at times quite close. It is to be hoped that none of you will turn his knowledge to his profit by becoming politically speaking a master machinist.

The duty of citizenship rests upon all of our citizens, but it applies in an especial measure to you who have received your education freely at the hands of the State. Socrates recognized so keenly the obligations which he owed the State by reason of the protection, education and other benefits he had derived from it that he refused to be persuaded to escape out of prison but remained there voluntarily to drink the poison. This kind of patriotism may seem a little fantastical to this practical age, but let me recommend a reading of the Crito and its philosophy as a needed strong tonic in an age when to escape punishment even though guilty is considered a mark of the successful man and when some of this republic's leading citizens expend considerable ingenuity in keeping out of jail.

But while I have advocated your taking an intelligent interest in public affairs I would emphasize the condition that it should be intelligent. There is a great deal of rambling and irresponsible criticism of persons who know things by persons who are ignorant. Much of this is directed against the administration of the present excellent school board. This is seen at every session of the Legislature and sometimes make its appearance in the City Council. Recently there was an attack by some of our City Fathers on vertical handwriting. Now what business have our City Fathers meddling with vertical handwriting? No more than they would have to reform the logarithm tables. I know absolutely nothing on the subject of vertical handwriting, but I claim superiority to these City Fathers in that I know that I know nothing, whereas they know nothing and yet think that they know. Likewise many amiable parents of pupils think they know how the children should be taught much better than those whose business and lifework is to teach. Such is the nature of the amiable parent and he must, I suppose, be endured.

We have a most excellent and competent superintendent of education here, who, I am happy to say, was imported from another State, because the whole country is none too large a field in which to explore when you are seeking for the best. There should be no petty jealousy as to this matter of geography. Baltimore is sending out her graduates from Johns Hopkins and other institutions into every State in the country. Why should we not bring in as we are sending out, import as well as export? We need free interchange in brains. The more we can get in, the better we become. I bespeak for Mr. Van Sickle, Mr. Hendrick and other men who come here well recommended, to help to advance the community, a hospitable welcome and a freedom from undue molestation. I bespeak for our excellent and hard-working school board the presumption that it is trying to do its duty intelligently and for the boys and girls who are to be the citizens of the next generation that the schools be kept out of politics and politics out of the schools. Education is an art and should be left in the hands of trained experts who are capable in that branch. The average parent knows little about it and the practical politician profanes it when he touches it. Keep the schools out of politics.

SOME RECENT EXAMINATION PAPERS.

STEAM ENGINEERING.

FOURTH YEAR CLASS—MAY 28, 1906.

1. Find the indicated steam consumption of the engine from which the given indicator diagram was taken.

2. Given: travel of valve, 5″; lead, ⅛″; cut-off, 65% of stroke; compression, 15% of stroke from end. Find: angle of advance, release, steam lap, and exhaust lap. Scale, full size.

3. What two methods are used for starting and stopping a boiler test? Describe each. How is the coal sampled, and the amount of moisture and of ash determined?

4. The result of an engine test shows 18 lbs. of steam per I. H. P. per hour. The steam is superheated 50° and has a pressure of 100 lbs. per gauge and temperature of 337.5°. There is a vacuum in the condenser of 26 inches, corresponding to a temperature of 126°. Find the thermal efficiency of the engine.

5. In a boiler test, the gauge indicated 100 lbs.; the temperature and pressure in a throttling calorimeter of the Peabody type were 345° and 2 lbs. per gauge respectively. Was the steam moist or superheated, and how much so?

6. Show that the weight of the reciprocating parts of a simple duplex engine is greater than those of a compound engine of the same power, the two types having in common: initial steam pressure, 115 lbs. absolute; exhaust pressure, 2 lbs. absolute; ratio of expansion, 8. For the compound engine, the receiver pressure is 28 lbs. absolute, and the ratio of cylinders is 4.

7. (For first section only.) Trace, with the aid of a sketch, the sequence of forces on the engine mechanism, starting with a variable steam pressure on the piston, and ending with the constant external resistance at the belt pulley.

8. (For second section only.) Find the size of cylinders for a compound engine to develop 70 I. H. P., the initial steam pressure being 135 lbs. absolute and the vacuum 26 inches. Assume: total ratio of expansion, 6; cylinder ratio, 3.13; piston speed, 450 per minute; mean pressure factor, 0.8.

MATERIALS OF ENGINEERING.

FOURTH YEAR CLASS—FEBRUARY 3, 1904.

1. What metals are used in forming alloys suitable for engineering purposes? What names are given the resulting compositions?

2. In the classification of iron and steel, what metals are known as malleable, semi-malleable, and non-malleable?

3. How is the quality of cast-iron affected by the different methods and fuels employed in its reduction? From what source does cast-iron absorb much carbon? What is the difference in character of cast-iron containing a high percentage of graphitic carbon and that containing a high percentage of combined carbon? What brand of pig-iron is much used in castings requiring the maximum of strength?

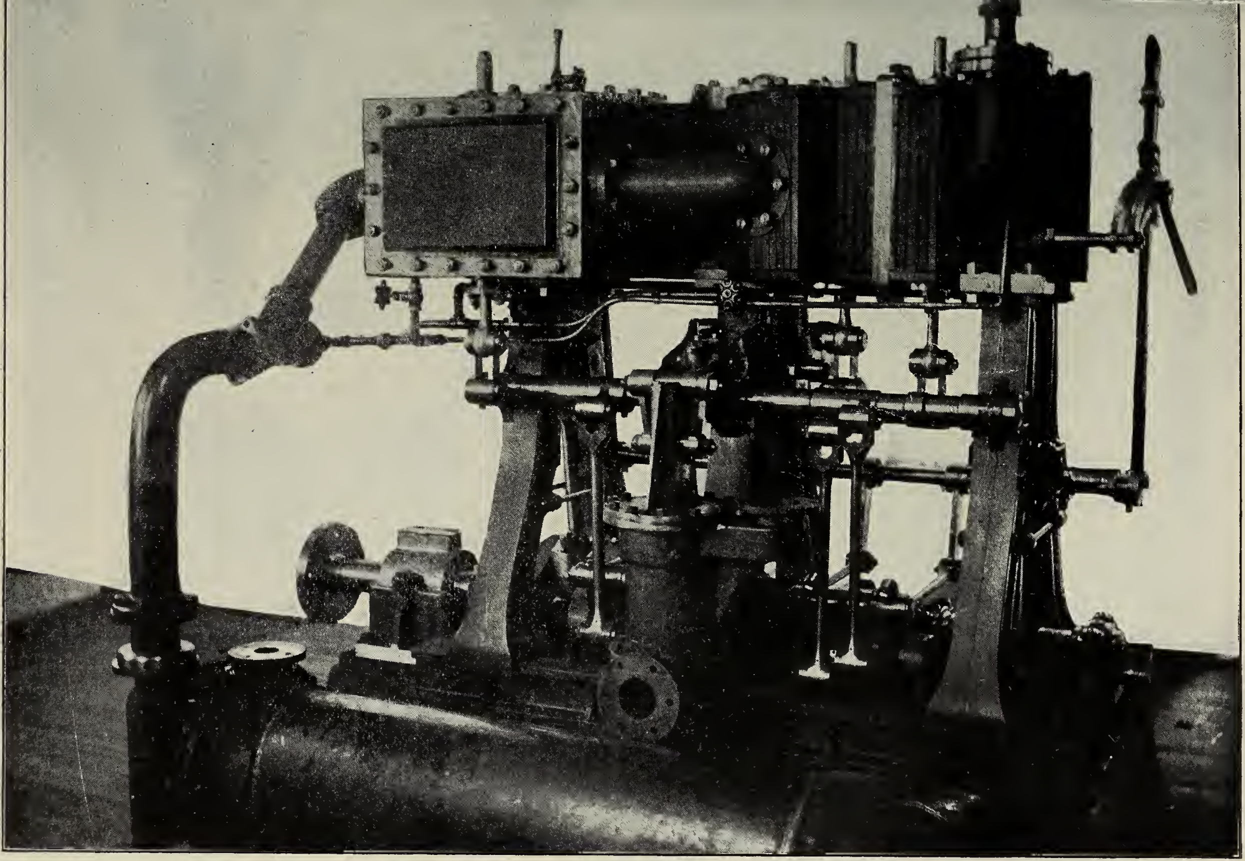
4. How can cast-iron be made partly malleable? Sketch and give dimensions of specimens of cast-iron for compression, transverse, and tensile tests. Give, as a result of your experience in testing, the average crushing, transverse, and tensile strength of cast-iron in pounds per square inch.

5. By what process is the most of wrought-iron produced? What element is nearly eliminated from the iron by this process? State some of the properties of wrought-iron. When testing wrought-iron, what have you found to be the average tensile strength per square inch, and the percentage of elongation in 8 inches?

6. By what process is wrought-iron converted into the high-grade steel known as tool steel? What is the process for converting cast-iron into mild, or structural, steel? Which of the two methods for converting cast-iron into structural steel is preferable when the material is to be used in the construction of boilers and shafting? Explain what is meant: (*a*) by the basic process; (*b*) by the acid process.

7. What impurities, other than carbon, are contained in steel? How are the strength and ductility of steel affected by the amount of carbon it contains? What is semi-steel?

8. Describe the different physical tests for structural steel. Make a sketch showing the forms and dimensions of specimens used for testing steel for boiler plates and for steel forgings. Given a forged steel specimen finished to ¾″ diameter and 2″ between centre dots; how would you proceed with the test?



TRIPLE EXPANSION ENGINE,

BUILT BY STUDENTS AFTER DESIGN OF THE BUREAU OF STEAM ENGINEERING, NAVY DEPARTMENT.

MECHANICS.

FOURTH YEAR CLASS—FEBRUARY, 1908.

1. Forces of 3, 5, and 7 units act on a particle at the center of a circle towards points on the circumference which divide it into three equal parts. Find the magnitude and direction of the force which will balance them.

2. A rod 8 feet long balances about its middle point with a weight of 5 pounds at one end, and a weight of 4 pounds at the other end; if the weight of 5 pounds be removed it is found that the rod will then balance about a point 20 inches nearer the other end: find the weight of the rod.

3. Three smooth pegs are fastened in a vertical plane so as to form an isosceles triangle with the base horizontal and the vertex downward, and the vertical angle is equal to 120 degrees. A fine string with a weight W attached to each end is passed under the lower peg and over the other two pegs. Find the pressure on each peg. Find also the vertical pressure on each peg.

4. Equal heavy particles are placed at each of five of the angular points of a regular hexagon. Find the distance of the center of gravity from the angular point at which no weight is placed.

5. A uniform rod of weight W and length $4a\sqrt{3}$ is just on the point of tipping when resting partly within and partly without a smooth hemispherical bowl of radius a. Find the inclination of the rod to the horizontal.

6. A crane has a vertical post 9 feet high, and a boom 18 feet long weighing 0.5 ton. The angle between the boom and post is 45 degrees, and a weight of 5 tons is suspended from the end of the boom. Find the tension of the tie joining the end of the boom and the top of the post; the horizontal pull at the top of the post; and the magnitude and direction of the thrust of the boom.

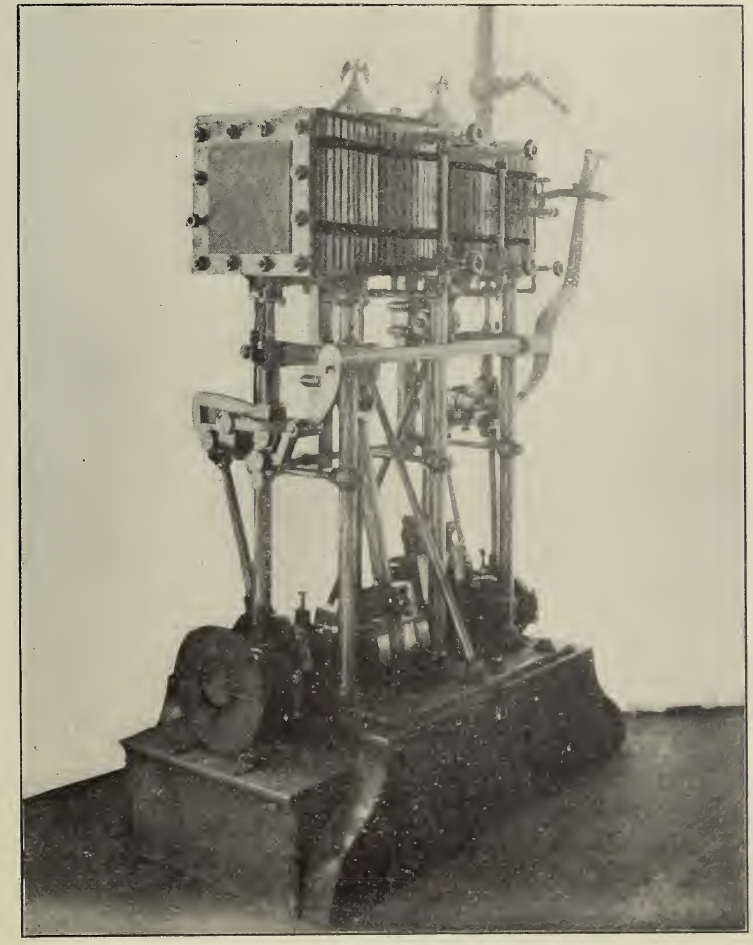
7. A uniform ladder 70 feet long is equally inclined to a vertical wall and the ground, both rough; a man with a hod, the combined weight being 224 pounds, ascends the ladder which weighs 448 pounds. How far up the ladder can the man ascend before it slips, the coefficient of friction between the ladder and wall being ⅓ and between the ladder and ground ½.

8. A body which weighs 3,456 pounds is placed on a smooth horizontal plane, and under the action of a certain force describes from rest a distance of 11 1/9 feet in 5 seconds. Find the force.

9. In how many hours would an engine of 18 H. P. empty a vertical shaft full of water if the diameter of the shaft be 9 feet, and the depth 420 feet. To what depth from the top of the shaft will the surface of the water be when the work is half completed?

10. An engine making 200 revolution a minute has its fly wheel belted with a 4 inch belt to a 12 inch pulley on a shaft which is making 400 turns a minute. The arc of contact of the belt on the pulley is 120 degrees, the coefficient of friction is 0.4, and the maximum tension per inch of width of belt is not to exceed 80 pounds. What horsepower is being transmitted?

11. The motion of an engine shaft is communicated to a shaft, A, by means of an open belt passing over the fly wheel, which is 36 inches in diameter, to a 15 inch pulley. The motion of shaft A is transmitted to shaft B by means of spur wheels of ⅞ inch pitch and of 43 and 24 teeth and an intermediate wheel. The motion of shaft B is communicated to the spindle of a fan by means of an open belt passing over pulleys of 18 and 12 inches diameter respectively. The stroke of the engine is 12 inches, the number of revolutions of the engine is 250, the mean pressure on the crank pin is 420 pounds, and the ratio of the tension in the tight and slack sides of the fly wheel belt is 2.25 : 1. Find: (*a*) the number of revolutions per minute of the fan; (*b*) the tangential pressure at the points of contact of the teeth in gear; (*c*) the horse-power at two or more stages of the transmission; (*d*) the difference of the tensions in the tight and slack sides of the fan belt.



COMPOUND ENGINE.

BUILT BY STUDENTS AFTER DESIGN OF THE BUREAU OF STEAM ENGINEERING, NAVY DEPARTMENT.

MECHANICS OF MATERIALS.

FOURTH YEAR CLASS—MAY 18, 1908.

1. A beam, whose supports are 12 feet apart, overhangs the left support 3 feet and the right support 5 feet, and is loaded as follows: 2 tons at the extreme left end, 2 tons 1.5 feet from it, 3 tons 5 feet from it, 8 tons 12 feet from it, and 6 tons at the extreme right end. Calculate the bending moment under each load, and find the points of inflection if there are any.

2. A wooden beam, supported at the ends and weighing 50 lbs. per cubic foot, is 20 feet long and 12 inches square in section. It supports a load of 2 long tons at the middle of its span. Calculate the fibre stress at the middle section.

3. A uniform beam of 24 feet span and supported at the ends, carries a uniformly distributed load, including its weight, of ⅓ of a ton per foot; also two concentrated loads of 2.4 tons and 6 tons at distances of 14 feet and 20 feet from the left support respectively. Find the bending moment at the dangerous section and at the section midway between the concentrated loads.

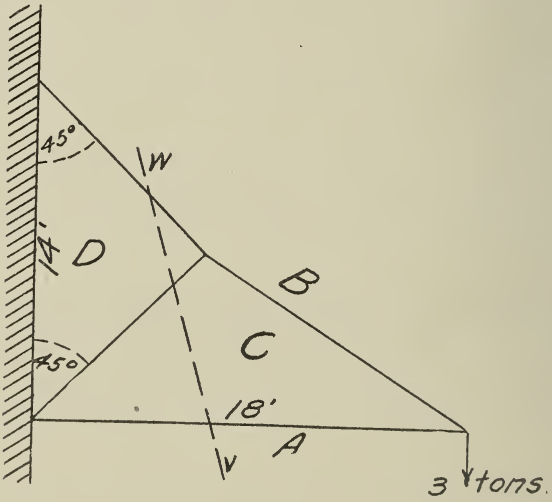
4. A 10 inch Cambria I beam, weighing 25 lbs. per foot, is laid across an opening of 16 feet. In addition to a concentrated load of 1,000 lbs. at the middle it bears a uniformly distributed load of 14,000 lbs. Find the maximum fibre stress and the maximum deflection, taking E as 29,000,000.

5. A 10 inch Cambria I column weighing 30 lbs. per foot and 12 feet in length, is secured with fixed ends in a building; find the safe load it will carry.

GRAPHIC STATICS.

FOURTH YEAR CLASS—MAY 20, 1908.

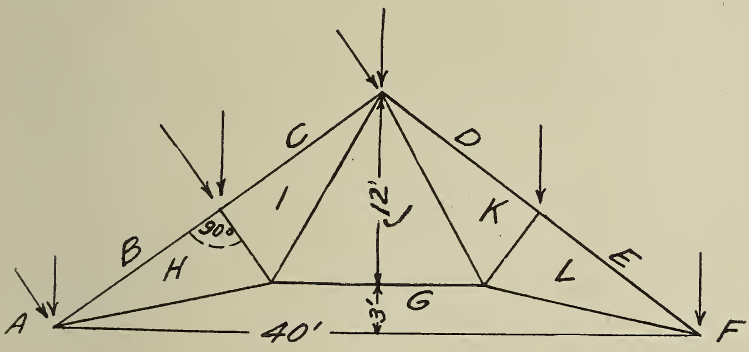
1. The framed cantilever of the figure supports a vertical load of 3 tons at its extremity. Find the stress in each member by means of the reciprocal diagram, and determine graphically the horizontal and vertical components of the wall reactions. Find by the method of sections the stresses in the members cut by *vw*.



2. A cantilever, 14 feet long, is loaded uniformly with 30 lbs. per foot, and has in addition a concentrated load of 150 lbs. at its extremity and one of 200 lbs. at 9 feet from the wall. Construct the bending-moment and shear diagrams. Scales: Linear, ¼ inch = 1 ft.; load, 1 inch = 400 lbs.

3. A uniform beam of 40 feet span and supported at the ends, is loaded uniformly for a distance of 25 feet from the left support with 1.2 tons per foot, including the weight of the beam. Draw the bending-moment and shear diagrams, and measure the bending moments at each of the following named sections: At the middle of the beam; at the middle of the load; at the end of the load; at the dangerous section. Scales: Linear, 0.1 inch = 1 foot; 1/20 inch = 1 ton.

4. The roof truss of the figure supports a uniformly distributed dead load of 2 tons, and is designed to be subjected also to a normal wind pressure of 19.2 lbs. per square foot. The distance between the principals is 14 feet. Assuming the wind to blow from the left side, and that the left end of the truss is fixed and the right end free to move on expansion rollers, it is required to determine from the reciprocal diagram the nature and magnitude of the stress in each member. Scales: Linear, ⅛ inch = 1 foot; load, 1 inch = 1 ton.



STEAM ENGINEERING.

THIRD YEAR CLASS—MAY 25, 1906.

1. Derive the formula showing the relation between degrees of temperature on the three scales: Fahrenheit, Centigrade, and Reaumur. How many degrees Centigrade is equivalent to 350° Fahrenheit?

2. If the pressure of saturated steam in pounds per square inch absolute is given, explain how to find the following quantities: temperature, sensible heat, total heat, latent heat, external heat, internal work, and specific volume. Where formulas are used, explain what the symbols mean.

3. Coal contains 85% C, 5% H, 6% O, the remainder being ash. The temperature of the air is 65° and 20 lbs. of it are used per pound of coal. The temperature of the chimney gases is 615°. The specific heats of nitrogen, carbon dioxide, superheated steam, and oxygen are 0.244, 0.217, 0.475, and 0.218 respectively. Find the temperature of the furnace, and the heat in the chimney gases per pound of coal.

4. Steam has a pressure of 100 lbs. per gauge, the corresponding temperature being 337.5°. Find the heat necessary to generate one pound of steam for the conditions: (*a*) dry and saturated; (*b*) 1.5% moisture; (*c*) 50° superheat. Feed water temperature, 126°.

5. During a boiler test lasting 48 hours, 144,000 lbs. of feed water are measured and 18,000 lbs. of coal are burned. The steam contains 1.5% of moisture, the pressure being 100 lbs. per gauge. The thermal value of the fuel is 15,000 B. T. U., and the temperature of the feed water is 126°. Find the boiler efficiency and the boiler horse power.

6. The result of an engine test gives 18 pounds of steam per I. H. P. per hour. The steam is of 100 lbs. pressure per gauge and is superheated to the extent of 50°. There is a vacuum in the condenser of 26 inches, corresponding to a temperature of 126°. Find the thermal efficiency of the engine.

7. Find the distance of the piston from each end of the stroke in a 9″x10″ engine, the crank-connecting-rod ratio being 1/6, and the crank making an angle of 120° with the head dead centre. What is the amount of the irregularity caused by the angularity of the connecting rod in this case?

PLANE TRIGONOMETRY.

THIRD YEAR CLASS—FEBRUARY 2, 1906.

1. Solve $\sin x + \sqrt{3}\cos x = 2$.

2. From the top of a light house, 109.67 feet high, the angle of depression of a boat was found to be 24° 2′ 20″. Find the distance of the boat from the base of the lighthouse.

3. Find the perimeter of a regular dodecagon circumscribed about a circle the circumference of which is one foot.

4. Tabulate the values of the sine, cosine, tangent, and cotangent of 0°, 30°, 45°, 60°, 90°, 120°, 135°, 150° and 180°.

5. Derive the formulas for the functions of double an angle.

6. Prove that $\frac{\sin 46^\circ + \sin 4^\circ}{\cos 46^\circ + \cos 4^\circ} = \tan 25^\circ$.

7. Find the value of $\sin(\tan^{-1}\frac{5}{12})$.

8. The base line connecting two observatories, A and B, is 600 feet. Find the distance of a point, C, from each, if the angles CAB and CBA are respectively 30° 25′ 20″ and 119° 34′ 40″.

9. Derive the formula for $\sin\frac{1}{2}A$ in terms of three sides of a triangle.

ANALYTIC GEOMETRY.

THIRD YEAR CLASS—JUNE 1, 1906.

1. Find the length of that part of the straight line, $3x-4y=0$ which is contained within the circle $x^2+y^2=25$.

2. A point, F, is situated at a distance of 6 inches from the line BC. A moving point, P, is always equidistant from F and BC. Find the equation of the locus of P.

3. Find the vertices and the area of the triangle whose sides are $2x+9y+17=0$, $y=7x-38$, and $2y-x=2$.

4. Find the angle formed by the lines $y=mx+b$ and $y=m'x+d$.

5. Find three forms of the equation of the circle referred to rectangular axes.

6. Prove that the latus rectum of a parabola is a third proportional to any abscissa and its corresponding ordinate.

7. Prove that the tangents drawn through the ends of the latus rectum of a parabola are perpendicular to each other.

8. Find the equation of the tangent to the hyperbola, $b^2x^2-a^2y^2=a^2b^2$ in terms of the co-ordinates of the point of contact.

9. Find the equation of the director circle of $b^2x^2-a^2y^2=a^2b^2$.

10. Describe the conchoid of Nicomedes and find its equation.

SURVEYING.

THIRD YEAR—JUNE 12, 1908.

1. Show, by drawing, a vernier reading 7.563.

2. From the following field notes, plot the field and calculate its area.

1.	N. 73° 30′ W.	5.00	chains.
2.	S. 16° 30′ W.	5.00	“
3.	N. 28° 30′ W.	7.07	“
4.	N. 20° 00′ E.	11.18	“
5.	S. 43° 30′ E.	5.00	“
6.	S. 13° 30′ E.	10.00	“

3. In the triangle ABC, AB = 12 chains, AC = 10 chains, and BC = 8 chains; part off a trapezoid of 1 acre 96 perches by the line DE parallel to AB.

4. Write the proper numbers in the third and fifth columns in this scheme, make a profile of the section, and determine the gradient per station:

Station	+ S	H. I.	- S	H. S.	Remarks
B	6.944				Bench on post 22 feet north of 0.
0			7.4		
1			3.9		
2			5.6		
3			4.6		
t. p.	3.855		5.513		
4			4.9		
5			3.5		
6			1.2		

DIFFERENTIAL CALCULUS.

FOURTH YEAR CLASS—FEBRUARY 7, 1906.

1. If $\frac{a}{x}$ approaches 0 as a limit and $\frac{b}{y}$ approaches 0 as a limit, prove limit $\frac{x+a}{y+b}$ = limit $\frac{x}{y}$.

2. Derive the formula for the differentiation of the product of two variables.

3. If $y = e^{-x} \cos x$ prove $\frac{d^4y}{dx^4} + 4y = 0$.

4. Derive the formula for the radius of curvature.

5. Compute the angle at which the following curves intersect:

$$y = 3x^2 - 1 \text{ and } y = 2x^2 + 3.$$

6. Find $\frac{dy}{dx}$ if $y = \frac{e^x - e^{-x}}{e^x + e^{-x}}$, if $y = \log(\log x)$.

7. What should be the ratio between the diameter of the base and the height of a tin cup in order that the amount of tin used in constructing it may be the least?

8. In the cissoid $y^2 = \frac{x^3}{2a - x}$ show that the subtangent is equal to $\frac{2ax - x^2}{3a - x}$.

INTEGRAL CALCULUS.

FOURTH YEAR CLASS—MAY 31, 1906.

1. Derive the formulas: (a) $\int \tan u \, du$; (b) $\int \frac{du}{u^2 - a^2}$.

2. $\int x^2 \cos x \, dx$.

3. (a) $\int (a \tan x \sec x + b) \cot x \, dx$; (b) $\int \frac{\sec x \tan x}{\tan^2 x - 2} dx$.

4. Find the area intercepted between the co-ordinate axes and the parabola $x^{\frac{1}{2}} + y^{\frac{1}{2}} = a^{\frac{1}{2}}$.

5. Find the volume of the prolate spheroid generated by the revolution of the ellipse $b^2x^2 + a^2y^2 = a^2b^2$ about the x axis.

6. Show that the volume generated by one semi-undulation of the curve $y = b\sin\frac{x}{a}$ is equal to one-half that of the circumscribing cylinder.

7. $\int \frac{x^3 - 1}{x^3 + 3x} dx$.

8. (a) $\int \sin^7 x dx$; (b) $\int \cos^4 x dx$.

9. $\int \tan^7 x \sec^3 x \, dx$.

10. $\int_a^b \int_c^d \int_e^f r^4 (dr)^3$.

11. Find the moment of inertia of the triangle formed by the axes and a line whose intercepts are *a* and b, about an axis which passes through the origin and is perpendicular to the plane of the triangle.

ELECTRICITY.

FOURTH YEAR CLASS—FEBRUARY 7, 1908.

1. A direct current six pole generator has an armature 20 inches in diameter. What should be the length of this armature? If the magnetic flux of a generator or motor is weak, what change could be made in the winding of the magnets to increase it?

2. Give winding scheme for first ten circuits of a four-pole, two-circuit armature, the number of cunductors being as nearly 400 as is consistent with good practice. With this armature, what flux would be required to generate 250 volts at 900 revolutions per minute?

3. How would a generator indicate the following defects: (*a*) An open circuit in one armature coil? (*b*) Demagnetized field magnets? (*c*) Disconnection in field circuit? (*d*) Improper position of brushes?

4. Outline the design of a 12 H. P., 125 volt, direct current, shunt wound motor, normal speed 1,000 R. P. M. The electrical efficiency and the efficiency of conversion are each 80 per cent. and the loss in the fields is 3 per cent. Calculate the current through the field wire.

5. What is meant by the ratio of transformation of a transformer? What is the effect of motors in the secondary circuit? In a good transformer, how great a difference exists between the currents in the primary and secondary? How great a difference exists between the phases of the secondary volts and the magnetic changes in the core?

ELECTRICITY.

FOURTH YEAR CLASS—MAY 22, 1908.

1. A three-phase, star-connected alternator has 40 turns per armature pole and makes 200 revolutions per minute. The flux per pole is 1,500,000 lines and there are 36 poles. What will be the line voltage? What would it be if the machine were delta connected?

2. A lighting system is installed and the insulation resistance required for it is 500,000 ohms. If the line voltage is 125, what must be the highest reading of an 18,000 ohm voltmeter when connected in the proper positions for testing? Give a diagram of a lamp ground detector, showing the generator and line lamps.

3. A three-phase transmission line indicates 12,000 volts between conductors and 75 amperes to a circuit. If the motors which are being operated have a power-factor of 85 per cent., what horse-power is being supplied? If a single-phase system gave the same indications, what power would be supplied?

4. Give a diagram of three compound dynamos connected in parallel, showing bus-bars, equalizer, ammeters, voltmeters, and circuit-breakers. Give the diagram for the Dobrowolsky three-wire system.

5. It is desired to operate 400 lamps, 55 watts each, at 78 feet, and 2 motors requiring 1 kilowatt each, at 90 feet. If a three-wire system, 250-125 volts, is used, and the drop is limited to 4 per cent, what size conductors should be used to supply the current? What current will pass in the main wires?

ANALYTIC CHEMISTRY.

FOURTH YEAR CLASS—FEBRUARY 4, 1908.

1. Give complete tests for the following bases: Silver, copper, barium, and potassium.

2. What reagent is used to separate members of the sulphuretted hydrogen group? What substances are included in each division? Which sulphides requires aqua regia to dissolve it?

3. When barium chloride is added to a solution for the purpose of indicating a group of acids, what is done to prevent some of the bases, such as silver and lead, from giving a precipitate with the chloride part of the reagent? How is a solution freed from ammonia before testing for potassium? Why is this necessary?

4. What is indicated by a yellow precipitate with molybdate of ammonia in a nitric acid solution? Give the test for a nitrate.

5. In what order are solvents applied to a powder? What substance is dissolved by ammonium acetate and acetic acid? How is barium sulphate brought into solution?

ANALYTIC CHEMISTRY.

FOURTH YEAR CLASS—MAY 26, 1908.

1. An ore is to be tested for per cent. of iron. The weight of the sample is 5 grams. This is titrated, after being dissolved, with a standard solution of $KMnO_4$ made by dissolving 5.644 grams of the crystals in water and diluting to 1 liter. The volume of this standard solution used in above test is 300 c. c. What per cent. of iron is indicated?

Equation: $2\ KMnO_4 + 10\ FeSO_4 + 8\ H_2SO_4 = ?$

Atomic weights: Mn, 55; K, 39; Fe, 56.

2. Describe the principal stages in making a gravimetric determination of sulphuric acid. How is the per cent. of suphuric acid calculated from the weight of the precipitate of barium sulphate? Ba, 137.

3. How much iodine will be required for 5 liters of standard solution to precipitate 0.0012 gram of sulphur to 1 c. c. of solution? What substance is used as an indicator in this test? I, 127.

4. Describe the method for determination of phosphorus.

5. Why is it necessary to use the double chloride of copper and potassium for dissolving steel for a carbon determination? What impurities must be removed before the carbon dioxide is absorbed? What part of the apparatus is weighed in this test? What multiple is used to find the weight of carbon?

GENERAL CHEMISTRY.

FOURTH YEAR CLASS—FEBRUARY 4, 1908.

1. What is the atomic theory?

2. In what manner does the weight of the atom determine the properties of an element?

3. What is solution? What is the effect of solution on chemical changes?

4. Give the reaction which takes place when the following chemicals are mixed: Sodium chloride and sulphuric acid; hydrochloric acid and sodium carbonate; sulphuric acid and copper; copper and nitric acid.

5. The volume of a quantity of carbon dioxide under 30 atmospheres pressure and at 80 degrees F. is 20 cu. ft. What did it cost to produce that amount of gas, if sulphuric acid and sodium bicarbonate cost 8 cents and 2 cents per pound respectively.

GENERAL CHEMISTRY.

FOURTH YEAR CLASS—MAY 26, 1908.

1. Where and in what conditions is sulphur found in nature? Give the details of the usual method of obtaining it from its ore. What are its characteristics? Name its principal compounds. Is there any similarity between sulphur and carbon?

2. Mention the chief sources of carbon; of silicon. Is there any similarity between them? Are they classed as acid forming or base forming? Which of the two is more widely distributed?

3. Name the three principal elements of the potassium family. Give their characteristic properties. Show how they are related. How obtained from their compounds? From what sources are they obtained?

4. Give the source of lead; method of preparation; its principal compounds; method of separating lead from silver. Wherein lies the danger in using lead for water pipes?

5. Give all the reactions and the weights of all the material necessary to make 500 kilograms of soda, using the Leblanc process.

AMERICAN HISTORY AND CIVICS.

SECOND YEAR CLASS—JUNE 10, 1908.

Omit any one of the first six and any one of the last six.

1. Trace the territorial growth of the U. S. down to the Civil War.

2. Explain fully the sectionalizing influence of the physiography of the eastern half of the U. S.

3. Trace the history of the Democratic party from its beginning through the administration of Jackson.

4. Give a full account of the Monroe Doctrine.

5. Give an account of the Dred Scott Decision, stating the causes leading to it, the decision of the court, the dissenting opinion, and the influence of the decision on the country.

6. Outline the successive steps, from 1861 to 1865, in the abolition of slavery; explain the nature and purpose of each step.

7. State and explain the distribution of the governmental powers in the U. S.

8. Give a full account of the organization of the two houses of Congress. Trace the steps by which a bill becomes a law.

9. Explain the method of electing a president of the U. S., stating how this method departs from the intention of the framers of the Constitution.

10. State at least three important arguments that have been advanced for the popular election of U. S. Senators.

11. "The Federal Supreme Court has rendered enormous service in the development of our Constitution." Explain and illustrate this statement.

12. Explain the organization of political parties in the U. S., and their part in our government.

ENGLISH.

THIRD YEAR CLASS—JUNE, 1907.

(This examination represents a half-year's work.)

Note—Answer all the questions. Bear in mind that this is no less an examination in composition than in literature. Return this slip with your completed papers.

I.—Discuss this statement: "We read 'Comus' today, not for its dramatic, but for its poetic quality."

II.—Explain what is meant by "literary conventions," referring for illustrations to "Lycidas."

III.—Show why Burke opposed the "project" of the "Noble Lord in the Blue Ribbon."

IV.—Discuss and account for several of the differences between the poetry of Pope and that of Wordsworth.

SPECIMEN ENTRANCE EXAMINATION PAPERS.

Set for Pupils Other Than Those Promoted from the Grammar Schools.

SPELLING AND PENMANSHIP.

Writing from dictation a paragraph or two of some standard text—Irving's Rip Van Winkle or Bancroft's United States History.

GRAMMAR.

I.—Use each part of speech in a different sentence, indicating the part of speech used in each sentence by underscoring and naming it.

II.—Define and give an example of a simple sentence, of a complex sentence, and of a compound sentence.

III.—Parse the underscored words in the following sentence: “By not heeding the counsels of our elders, how often do we lose what we should gain!”

IV.—Analyze the following sentence: “If we send the sailors a message in time, they will help us when the savages attack us.”

V.—Write sentences illustrating the correct use of any perfect tense of each of the following verbs: sit, set, seat, lie, lay, write, go.

COMPOSITION.

The subject set is a description of some well-known place or object, or an account of some historical event.

UNITED STATES HISTORY.

1. What country was each of the following explorers serving when he came to America, and what territory did he discover or explore: Columbus, De Soto, Drake, Cartier.

2. Locate the settlements of the French, the Spanish, the Dutch.

3. Give a brief account of the settlement of Maryland.

4. Give a brief account of the wars between the English and French, extending from 1689 to 1763. State causes and results.

5. (*a*) State several causes of the Revolutionary War. (*b*) Name four important battles of the Revolution, and give a brief account of each.

6. What were the “Articles of Confederation,” and why, and by what, were they superseded?

7. What is meant by “The Missouri Compromise?”

8. Name the principal causes of the Civil War. Who commanded on each side at Gettysburg? Why was the battle of Gettysburg so important?

9. What reason did the United States assign for going to war with Spain in 1898? What territory did the United States require as a result of that war?

ARITHMETIC.

1. Divide 5.375 by 0.0125, obtaining the exact result.

2. Simplify $\frac{1 + 0.5}{1 - 0.5} \times \frac{0.05 \div 0.005}{0.005 \div 0.05} - \frac{0.4\frac{1}{2}}{0.22\frac{2}{9}}$

3. A merchant's sales on Monday amounted to $385.84. His sales on Monday were 16 2/3% of 54% less than the amount of goods sold on Tuesday. What was the amount of Tuesday's sales?

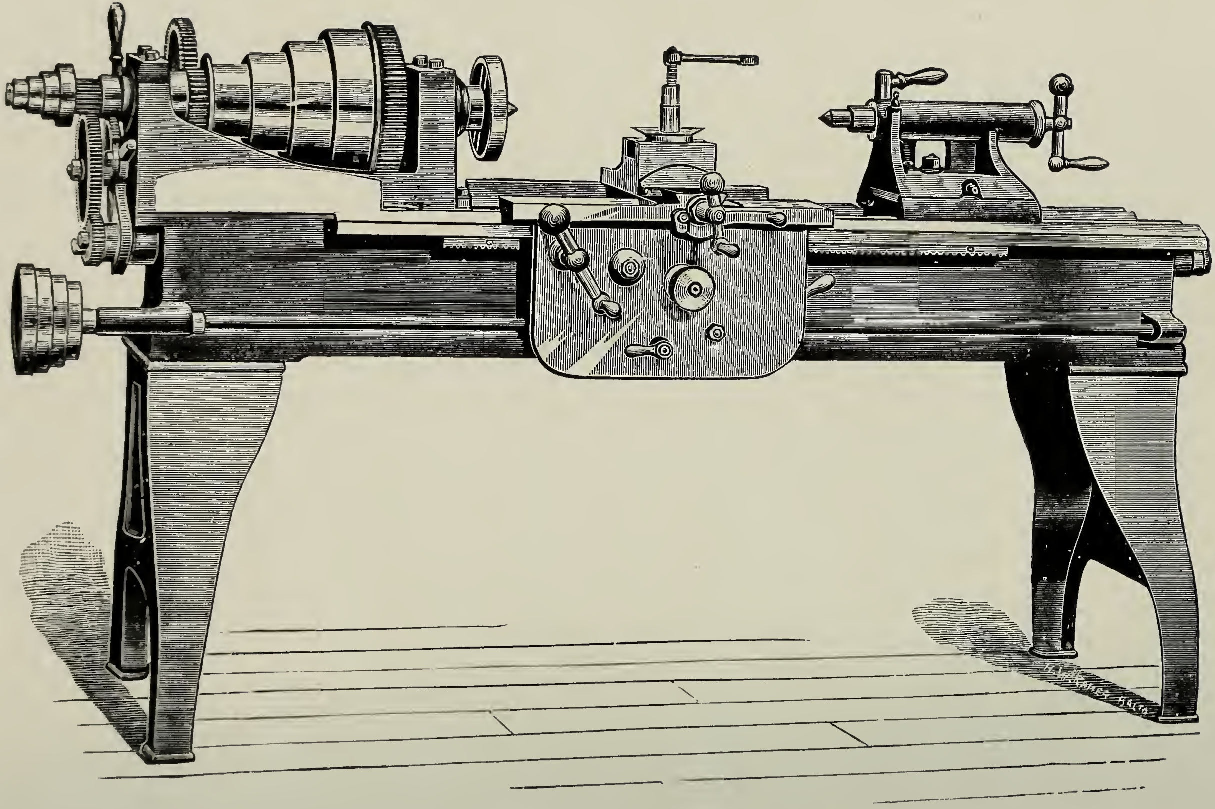
4. A firm sold an engine for $7,050, thereby losing 6%; for what should it have been sold in order to gain 12%?

ALGEBRA.

1. Factor the expressions: $a^2 + 6ax + 5x^2$, $n^{10} - 16n^5 - 80$, and $1 - 9x - 36x^2$.

2. Simplify $\left[(a^2 - x^2) \div (\frac{1}{x} - \frac{1}{a})\right] - \left[(a^2 - x^2) \div (\frac{1}{x} + \frac{1}{a})\right]$.

3. Given $\frac{2x+1}{5} - \frac{3y+2}{7} = 2y - x$, $\frac{3x-1}{4} + \frac{7y+2}{6} = 2x - y$, find the values of x and y.



BUILT BY STUDENTS

CATALOGUE OF STUDENTS.

(Corrected to February 1, 1908.)

Students whose names are marked with an asterisk (*) received 85% or more of the possible multiple for the year.

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Morris H. Goldberg,
Walter L. Goldman,
William S. Graham,
Earl A. Greene,
Otto Gronert,
Theodore W. Hacker,
Gaylord W. Hall,
Edward Hain,
S. Dashiell Hammett,
Joseph O. Hannibal,
Franklin B. Harper,
Wilbur Harrison, Jr.,
Walter Harrison,
Stuart B. Harnett,
William J. Harnett,
James W. Hartman,
Leo H. Healey,
William F. Heimiller,
Karl Heineman,
Clarence W. Heisse,
John W. Heisse,
Joseph M. Hernick,
Irving Hess,
James W. Higgins,
Clarence L. Hill,
Charles A. Hiss,
Josiah S. Hochheimer,
Abraham Hollander,
James E. Hopkins,
Frank C. Horlebein,
J. Henry Horn,
Carl W. Horn,
L. Stedman Houghton,
Harry V. Howser,
Harry C. Huhges,
George E. Hull,
Stanley R. Hyson,
H. Leroy Irving,
Morris Jacobs,
Thomas W. Jamison,
John Jaworsky,
Harry Johnson,
Clinton M. Jones,
Frank Karger,
L. W. Keimig,
Kenrick Kelly,
Charles M. Kelly,
Frank P. Kennedy,
Howard B. Kleas,
Hugh D. Klitch,
Clarence D. Knight,
Paul B. Koons,
Harry Korff,
Abraham N. Krieger,
Irving G. Kroll,
Edward Kuehn,
John Kungis,
Benjamin Lasinsky,
Richard J. Laughlin,
Charles R. Lawton,
Allen D. Lazenby,
Herbert L. Lee,
James Irvin Lederer,
Louis F. Lenderking, Jr.,
Francis Lentz,
Eugene B. Link,
Frank W. Littleton,
Walter A. Lloyd,
Carroll R. Long,
Frank Lucke,
Earl Lutz,
Marion McComas,
Harry J. McGreevy,
Frederick Maag,
William H. Marshall, Jr.,
Joaquin Masferrer,
Otto Mattfeldt,
Joseph Matusevitz,
Lawrence R. Meekins,
Alexander C. Meikel,
C. Alexander Mengers,
Paul Messersmith,
J. Edward Metzbower,
Alfred C. Meyer,
Louis Michaelson,
Rudolph Michel,

Paul B. Milburn,
F. Wilson Miller,
William Miller,
William R. Monks,
W. R. Moore, Jr.,
William H. Munroe,
Osborne Murphy,
William H. Nickols,
Alfred S. Niles, Jr.,
Harry Noel,
James H. Onion,
Philip O. Palmstrom,
Andrew Pardew,
Gordon Parks,
Raymond C. Parlett,
Nathan Perry,
Earl S. Piersol,
Samuel C. Pruett,
A. J. Quinan,
Arthur W. Rae,
Gustav Rasch,
Robert A. Reitz,
Harry W. Richards,
John Rickert,
Leslie J. Riesett,
James Riley,
W. Emerald Ring,
Harold Robinson,
Graham Rodemeyer,
Emmeroy Rohr,
Reuben Rosenstein,
Max Rudo,
Charles Rueffel,
Raymond W. Russell,
G. Hulbert Sack,
William Sandlas,
William Sapp,
J. Leon Sarbucker,
J. Albert Schad,
Leo Scharfe,
Lester A. Schloss,
Frederick Schmidt,
John E. Schmidt,
Michael P. Schmidt,
Erich Schmied,
Howard Schuster,
William H. Scott,
Hanson Seal,
Glymoore T. Sherwood,
Louis E. Shilling,
Walter Siebert,
Harold R. Siemers,
Henry Victor Sinclair,
Isadore Sindler,
Walter J. L. Smith,
Courtland Smithers,
William H. Solomon,
Charles H. Spence,
Howard Snyder,
W. E. Stackhouse,
Herman B. Stagge,
Alexander E. Stehley,
William P. Stein, Jr.,
E. Raimon Stivers,
John C. Strott,
Harry W. Sumwalt,
Edwin Talbott,
Medford G. Talbott,
Otis J. Tall, Jr.,
James B. Tarr,
Samuel LeR. Thomas,
Edward J. Thomas,
William H. Through,
Frederick T. Tiemeyer,
Harry Timm, Jr.,
James P. Tippett,
Frederick C. Traub,
Oliver Travers,
Charles E. Uhler,
Spencer S. Unglaub,
Vincent M. Victor,
John William Wagner,
George E. Waldkoenig,
Carl Walker,
William F. Walker, Jr.,
J. Leonard Walsh,

Sigwid Walter,
G. Robert Wannenwetsch,
Rowe Ward,
Carlton A. Warner,
Nelson Warren,
Charles B. Watkins,
Carroll D. Weatherby,
Sylvanus R. Weaver,
Charles F. Webb,
James D. Webb,
Ormsby Webster,
Josephus L. Welsh,
William C. Wheatley,
Stevenson White,
John W. White,
Bernard W. Wheeler,
Chrystal C. Williams,
Francis Wilson,
Stewart Wilson,
William P. Winzer,
Reuben T. Wisthoff,
Edward Wohrna,
T. Roby Wolfe,
Sidney N. Wolman,
Richard F. Wood.

MID-YEAR CLASS OF 1913—54 MEMBERS.

Joseph Argabright,
Abram Bacharach,
Louis Baer,
Rafael Bernabe,
Carlyle E. Boone,
Edward Walter Borst,
Leigh A. Brodie,
Manuel Carrera,
Euripdes de Castro,
Frank A. Cesky,
Ralph H. Cline,
Samuel Cohen,
Laurence E. Collins,
Robert L. Condit,
E. Stanley Davis,
Joseph Emden,
Joseph Goldstein,
Arthur Graham,
E. Guy Gray,
Henry F. Grieneisen,
C. C. Guise,
Alexander Hack,
Parker Hahn,
E. Albert Hampson,
Roswell C. Haynie,
J. Nathaniel Heiner,
Walter Hess,
E. Paul Homburg,
Isadore Isaacs,
C. Laurence Kaspar,
William J. Kellinger,
W. Rouse Kelly,
Alexander Klitch,
Eugene H. LaMar,
William Leinweber,
Julius Levine,
Ernest Minor,
Carroll Morrison,
Howard P. Nelson,
Harl H. W. Peltz ,
Charles L. Pumphrey,
Arthur Ridgely,
George Rosett,
Clinton E. Sevier,
William Shater,
Julius Sommer,
Israel K. Steinberg,
Ralph C. Talbott,
Herbert Thompson,
Bernard Trautman,
Isaac Tretick,
Samuel T. Wheatley, Jr.,
Ernest Wood,
LeRoy Young.

SUMMARY OF ENROLLMENT.

Class of 1909, A Class	63
Mid-Year Class of 1910, Ax Class	19
Class of 1910, B Class	85
Mid-Year Class of 1911, Bx Class	38
Class of 1911, C Class	192
Mid-Year Class of 1912, Cx Class	45
Class of 1912, D Class	280
Mid-Year Class of 1913, Dx Class	54
Total enrollment	776

CLASS ORGANIZATIONS.

CLASS OF 1909—A CLASS.

President	Elmer Heubeck.
Vice-President	Gibbs La Motte.
Secretary	Douglas C. Corner.
Treasurer	Roy D. Fleckenstein.

MID-YEAR CLASS OF 1910—A*x* CLASS.

President	Alfred Mullikin.
Vice-President	George E. Green.
Secretary	Edward H. Lange.
Treasurer	Herman A. Weighardt

CLASS OF 1910—B CLASS.

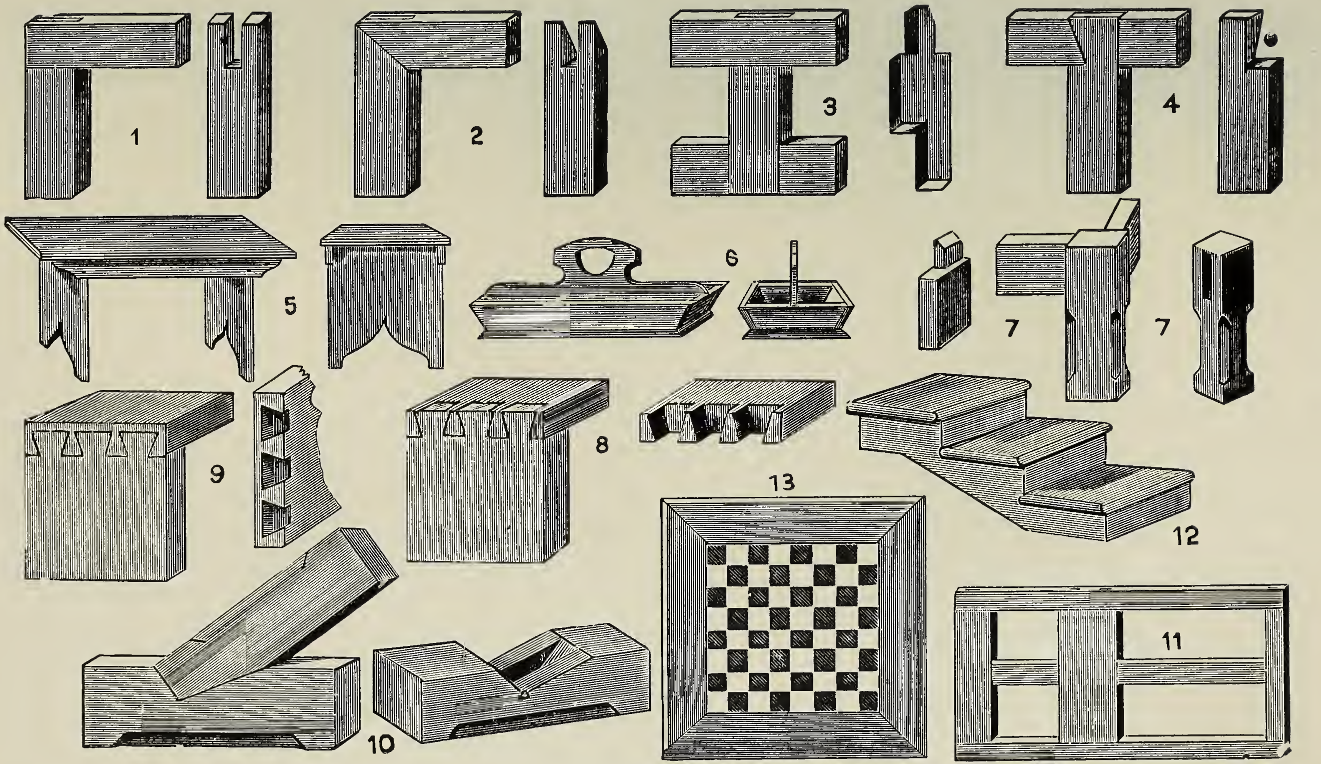
President	H. B. Lyon.
Vice-President	T. C. Slingluff.
Secretary	C. T. Harris.
Treasurer	H. T. Carr.

MID-YEAR CLASS OF 1911—B*x* CLASS.

President	William Schaefer.
Vice-President	Norman Stansbury
Secretary	John Z. Bayless.
Treasurer	Harry Gaither.

CLASS OF 1911—C CLASS.

President	Walter E. Vail.
Vice-President	C. W. Keefer.
Secretary	C. J. Kearney.
Treasurer	Conrad Zieget, Jr.



CARPENTRY.

MID-YEAR CLASS OF 1912—Cx CLASS.

President	Paul H. White.
Vice-President	Adolph W. Boysen.
Secretary	Paul R. Dankmeyer.
Treasurer	Charles R. Baughman.

CLASS OF 1912—D CLASS.

President	William C. Wheatley.
Vice-President	F. B. Harper.
Secretary	Earl L. Greene.
Treasurer	F. Wilson Miller.

LITERARY SOCIETIES.

The literary societies, membership in which is voluntary, meet on Friday afternoons during the academic year.

THE "LOWELL."

President	F. B. Abbott, '09.
Vice-President	L. B. Chenoweth, '10.
Secretary	P. McK. Teeple, '10.
Treasurer	J. Blaustein, '10.
Sergeant-at-Arms	C. J. Kearney, '11.
Reporter	P. McK. Teeple, '10.
Executive Committee	W. N. Van Sant, '09. E. C. Schaun, '11. The President, *ex-officio.*

THE "POE."

President	Walter F. Perkins, '09.
Vice-President	R. Brooke Hopkins, '09.
Secretary	Conrad Zieget, '11.
Treasurer	Carlos Soler, '09.
Sergeant-at-Arms	J. Fred Gross, '11.
Reporter	Claude W. Keefer, '11.
Executive Committee	Louis A. Deliz, '09.
	Carroll T. Harris, '10.
	The President, *ex-officio.*

On December 12, 1908, the question "Resolved: That Federal boards of arbitration with compulsory powers would prove the most efficient means of settling labor disputes," was publicly debated at the Eastern High School by a team from the Lowell and one from the Bancroft Literary Society of the Baltimore City College, the former maintaining the affirmative and the latter the negative. The debaters representing the Lowell were Emory H. Niles, '09; Wilbur N. Van Sant, '09; Frederick B. Abbott, '09; and Jacob Blaustein, '10, alternate. The judges, Messrs. Robert H. Smith and James U. Dennis, of the Baltimore bar, and Dr. John C. French, of the Johns Hopkins University, decided unanimously in favor of the Lowell.

ATHLETICS.

THE ATHLETIC ASSOCIATION.

The fundamental basis upon which rests the organization of the Athletic Association is the elevation of schoolboy athletics. It seeks to establish honor, self-restraint, and courage above victory. It provides suitable apparel and safety devices for contestants in order to lessen the chances of injuries, and endeavors to shape the coaching and training on hygienic principles. It permits any student of the Institute to become a candidate for any team or squad which represents the school in athletic contests, provided his scholastic standing is of the required standard.

To make the association thoroughly representative of the student body, each section of a class is accorded a representative on the Athletic Board, which secures a representative ratio of 1 in 30.

ORGANIZATION OF THE ATHLETIC ASSOCIATION.

President	Gibbs La Motte.
Vice-President	John Bayless.
Secretary	Elmer Heubeck.
Treasurer	Mr. Dougherty.

ATHLETIC BOARD.

E. Heubeck, '09.
G. La Motte, '09.
G. A. Chase, '10.
J. B. Norris, '10.
L. Cummings, '10.
E. Bryan, '10.
J. Bayless, '11.
N. P. Stansbury, '11.
C. A. E. King, '11.
W. T. Snyder, '11.
A. Heubeck, '11.
H. E. Peddicord, '11.
J. W. Downes, '11.
G. Bayless, '11.
J. W. La Motte, '12.
O. Webster, '12.
L. Scharfe, '12.
R. Parlett, '12.
L. E. Shilling, '12.
L. Baldwin, '12.
R. N. Atwell, '12.
R. F. Wood, '12.
R. Burgesser, '12.
W. E. Seibert, '12.

BASEBALL.

The advantage to the team of having for the first time a practice field was practically offset by the lack of seasoned material in the make-up of the team. To break even on the results of the games played was a satisfactory performance, and as practically the whole team is still in school the outlook for next season is promising. The team of 1908 was:

Dalrymple, Drenning, Lamley, Pitchers; Callahan, Catcher; Clancy, First Base; Buck (Captain), Second Base; Dalrymple, Drenning, Third Base; Tapking, Short Stop; Maxwell, Right Field; Fallon, Center Field; Kauffman, Right Field.

Substitutes: Siems, Davis, Goldenberg, Scheaffer.

The following is a summary of the games played:

Polytechnic, 6........Jefferson School, 0.
Polytechnic, 6........Washington College, 12.
Polytechnic, 4........Revenue Cutter Cadets, 8.
Polytechnic, 3........Revenue Cutter Cadets, 5.
Polytechnic, 21........Loyola College, 14.
Polytechnic, 11........Loyola College, 0.
Polytechnic, 7........Country School, 6.
Polytechnic, 10........Country School, 0.
Polytechnic, 4........Episcopal High School, 7.
Polytechnic, 6........Charlotte Hall, 3.
Polytechnic, 4........City College, 12.
Polytechnic, 4........City College, 11.
Polytechnic, 1........Johns Hopkins Freshmen, 1.
Polytechnic, 3........University of Maryland, 2.

FOOTBALL.

The athletic goal for which the Polytechnic has striven for years was reached on November 20 at Oriole Park, when, at the annual football game, the colors of the City College were laid low by the score of 11 to 0. It was the first football victory ever scored by the Polys over their dearest foe, but it was none the less clean-cut and decisive. Another maiden victory for the Polys was their defeat of the Tome Institute team at Tome on October 3rd. Next in importance to the City College game was that on Thanksgiving Day with the Navy Plebes (Fourth Class Midshipmen) on the Naval Academy grounds, and though defeated, the Polys held the Plebes to the smallest score in the annals of these games.

Altogether, it was the most successful football season in the history of the Institute. The following is a summary of the games played:

September 26, at Chestertown—Polytechnic, 0; Washington College, 0.

October 3, at Tome—Polytechnic, 17; Tome Institute, 0.

October 14, at Mt. Washington—Polytechnic, 39; Loyola College, 0.

October 17, at Ellicott City—Polytechnic, 0, Rock Hill College, 0.

October 24, at Charlotte Hall—Polytechnic, 17; Charlotte Hall, 0.

October 31, at Millersville, Pa.—Polytechnic, 0; Penn. State Normal, 5.

November 7, at College Park—Polytechnic, 5; Md. Agricultural College, 12.

November 20, at Oriole Park—Polytechnic, 11; City College, 0.

November 26, at Annapolis—Polytechnic, 0; Navy Plebes, 10.

THE TEAM.

Left End	Edgar Bryan.
Left Tackle	Andrew Heubeck.
Left Guard	Wilfred La Motte.
Center	George Chase.
Right Guard	George Bayless.
Right Tackle	John Bayless.
Right End	Tom Slingluff.
Quarter Back	C. A. E. King.
Full Back	Charles Baughman.
Left Half Back	Elmer Heubeck.
Right Half Back	Gibbs La Motte (Capt.).

Substitutes—W. Dalrymple, O. D. Shepard, W. Perkins, C. Cann, F. LaMotte, P. Waldschmidt, C. Soler, C. Emory.

Coach—Mr. W. S. Bayless.

THE CHESS CLUB.

President	E. Kennard, Jr.
Vice-President	E. F. Koester.
Secretary	F. E. L. Wich.
Treasurer	L. Cremona.

THE ORCHESTRA.

Director	J. O. Mirski.
J. O. Mirski	First Violin.
C. Mengers	First Violin.
F. C. Stauffen	Second Violin.
F. Neumann	Second Violin.
L. Deliz	Flute.
C. Zieget	First Cornet.
G. Forster	Second Cornet.
F. Schwartz	Oboe.
J. R. E. Hiltz	Piano.
A. C. Fankhanel	Drum.

GLEE CLUB.

Manager ....Mr. Samuel M. North.
Director.............................Louis Cremona.
Pianist..............................J. R. Emmett Hiltz.

First Tenors.

Henry C. A. Meyer, Jay Stoudenmire,
Wallace Everton.

Second Tenors.

Julius O. Mirski, Louis Cremona,
R. Brooke Maxwell.

First Basses.

W. B. O'Connor, Carroll T. Harris,
A. W. Jahn.

Second Basses.

George A. Chase, R. Bruce Drenning.
J. Clark.

Chorus.

W. Thomas, L. K. Thompson, C. J. Flayhart,
Luis A. Deliz, O. M. Bloch, R. A. Booth,
George Fultz, H. L. Weaver; H. C. Randall,
J. Bohnlofink.

CATALOGUE OF GRADUATES.

CLASS OF '87.

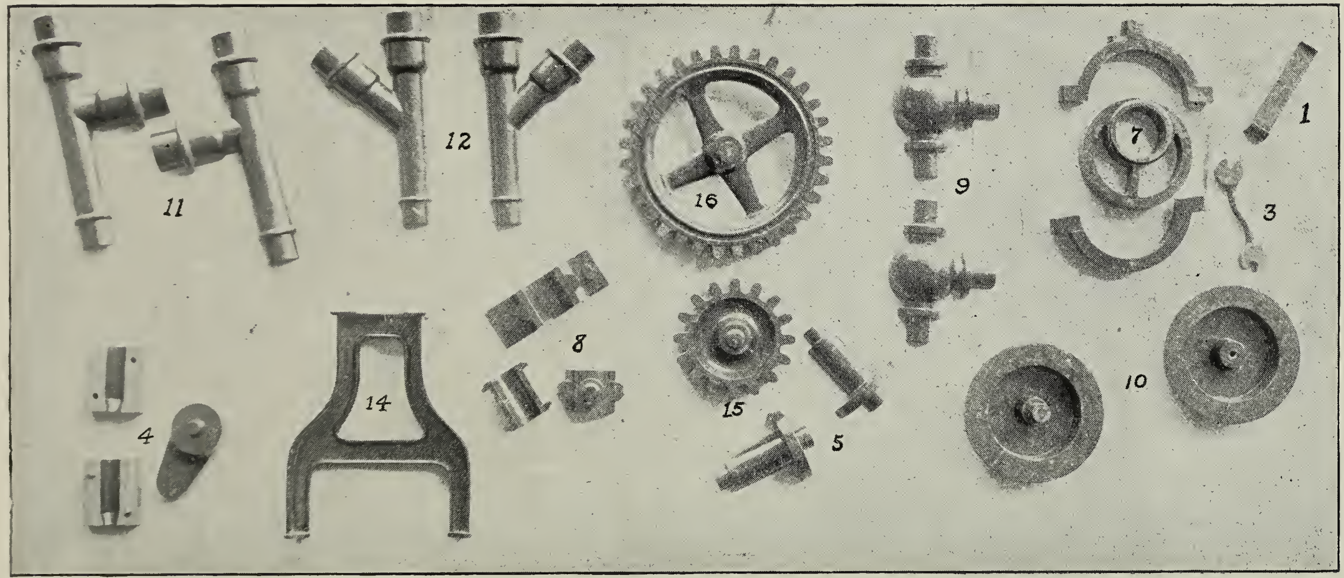
Clarence G. Bouis,
George C. Bump,
Lucien Dallam,
Otto H. Ehlers,
Osma K. Gardner,
Herbert F. Gorgas,
Joseph Greenbaum,
Henry W. Hahn,
Minor F. Heiskell,
Robert Hooper,
William S. Hugg,
Thomas J. Irons,
Joseph H. Kuehn,
P. Charles Nelson,
Flavius J. Pennington,
Richard Piez,
Henry M. Price,
Walter G. Reinicker,
William A. Robertson,
Albert Rosenberg,
James B. Scott,
Walter R. Sweeney,
James C. Thompson,
Adolphus Tiemeyer,
Frederick H. Wagner.

CLASS OF '88.

Arthur O. Badendrier,
Edward Binswanger,
Bernard H. Brooke,
Sydney S. Bouis,
Julius Fireman,
Thomas G. Ford,
George M. Gaither,
John H. Harvey,
Howard Harvey,
Walter J. Herrman,
Joseph H. Hooper,
John P. Jefferson,
William Johnston, Jr.
William Mencke,
William F. Mylander,
Edwin F. Orem,
Edward B. Passano,
George E. Repp,
Harry E. Roberts,
George C. Robinson,
Hanson Robinson,
Robert E. Rodgers,
George H. Sickel,
Washington B. Stanton,
Orlando C. Weeks.

CLASS OF '89.

William F. Ackerman,
Samuel R. Adams,
Morgan H. Baldwin,
Arthur Gordon,
Ernest Griffith,
Isaac Behrend,
Joseph Isaac,
Louis H. Gerding,
Harry M. Ford,
Edward P. Cromwell,



PATTERN WORK

John S. Hand,
Claiborne M. James,
Albert C. Layman,
Charles W. Leach,
J. W. C. Meikle,
Rozier L. Bouis,
Robert H. Buschman,
Charles C. Constantine,
Albert T. Barrett,
John L. Ehrman,
Allyn Field,
Howard Crosby,
George W. Moog,
John K. Mount,
Robert W. Peach,
Charles E. Phelps, Jr.,
William G. Robertson,
Robert C. Round,
Myron S. Rose,
William C. Siegmund,
Joseph Stiefel,
Harry P. Suman,
Carroll Thomas.

CLASS OF ’90.

John F. Abendschein,
G. S. Barnes,
J. H. Bokee,
J. Edward Broadbelt,
W. H. Fahrinholt,
Chris. Feick,
J. Froelich,
William P. Gundry,
E. C. Harris,
J. C. Mattoon,
John D. Pugh,
A. O. Robertson,
William F. Schultz,
Michael D. Schaefer,
William P. Shriver,
Theodore Straus.

CLASS OF ’91.

Walter Amos,
Basil Benson,
William Benson,
William Boucsein,
Morde Bren,
John J. Caine,
George Dannetel,
Charles Ehlers,
Ferdinand B. Keidel,
J. Edgar Knipp,
Samuel McNeal,
James C. Phillips,
Herbert M. Reese,
Edmund W. Robinson,
Reuben Row,
Warren S. Seipp,
N. D. D. Sollers,
Richard S. Warner,
William A. Young.

CLASS OF '92.

Edwin W. Antes,
John P. Baer,
Frank J. Borie,
B. Harrison Branch,
Leonard Burbank,
William C. Butler, Jr.,
Frank B. Hooper,
Edgar N. King,
John Langford,
Louis Liepman,
R. M. Miller,
J. W. Dawson, Jr.,
Royal R. Duncan,
Charles R. Durling,
Isidor Deutsche,
Walter H. Eisenbrandt,
William T. Holmes,
J. C. Miller,
Joseph Mullen,
William H. Rose,
Albert G. Singewald,
William H. Soine,
William E. Straus.

CLASS OF '93.

Theodore H. Ackerman,
Herbert Addison,
Oregon R. Benson,
Percy Thayer Blogg,
C. Raymond Carson,
William John Cochran,
E. C. D'Yarmett,
Henry M. Fitzhugh,
Clarence S. Hand,
James F. McShane,
Clarence F. Morfit,
F. H. Phelps,
Edwin Schenck,
John R. Uhler,
L. Ismay Van Horn,
Charles P. Weishampel,
R. L. Williams.

CLASS OF '94.

Edward H. Bell,
Albert E. Bowen,
J. Straith Briscoe,
Harry Cotton,
Carroll Edgar,
Frederick Kopp,
Philip Littig, Jr.,
Thomas Q. McGinn,
Herbert A. McGaw,
Horace J. Miller,
Louis Mueller,
George M. Parlett,
Charles Schlicker,
Alan P. Wilson,
John Zeubert,
Pliny Cutler Hall,
Edward J. Herring.

CLASS OF ’95

George W. Brown,
Clifton A. Coggins,
Harry W. Francis,
Graham B. Hall,
William W. Hogendorp,
Albert J. Hooper,
Frank A. Hornig,
Howard L. Hoskins,
Edward M. Likes,
Ward P. Littig,
Alfred F. Loeser,
Thomas J. H. Magness,
Herman F. Meyer,
George N. Rogers,
Hamilton D. Ruth,
Richard F. Weishampel,
Carl A. Witthaus.

CLASS OF ’96.

Samuel Hosea Armstrong,
Howard Douglas Bennett,
James Gomelia Boss, Jr.,
William Augustine Boykin, Jr.,
Robert Lemmon Burwell,
Harry Parr Diggs,
Frederick L. H. Glendmeyer,
William Howard Hamilton,
Arthur Worthington Hawks, Jr.
Fredk. Worthington von Stein,
Louis Kemp Henninghausen,
Harry Louis Homer,
Ludford Cohoon Jones,
Leon Alvyn Kohn,
Erich Albert Loeser,
Henry Louis Mencken,
Harold Vincent Patterson,
Harry Clay Powell, Jr.,
Gilmor Meredith Ross,
Thomas Quincy Scott,
Henry Bonn Silverthorn,
William Henry Smith,
Roscoe Conkling Sweeny,
Charles Edwin Wilson,
Olin Alexander Wilson.

CLASS OF ’97.

Louis Fabian Bachrach,
Alan Marion Bennett,
William Melvin Carter,
Elvin Griswold Cromwell,
John Towson Elsroad, Jr.,
John Montgomery Gambrill,
Ernest Cummins Hatch,
William Hain Kirwan,
Harry L. Kugler,
Chester Waters Larner,
Howard Osgood Preston,
George Gottlieb Schnepfe,
Frederick Lewis Schwartz,
Joseph Stewart Smith, Jr.,
Douglas Alan Sparks,
Joseph Morrison Sparks,
Wilson Ward.

CLASS OF '98.

Thomas Jefferson Andrews,
Alan Joseph Bachrach,
Leo Bauerfeld,
Wilbur McKnew Bosworth,
Frederick Derick Dollenberg, Jr.
Romulus Griffith Doyle,
John Howard Flayhart,
Henry Galloway,
Charles Raymond Gantz,
Samuel Thomas Griffith,
Alfred Cummins Hatch,
William Herman Hubers, Jr.,
Joseph Lowrie Ingle, Jr.,
John Scott Longnecker,
John Walter McGreevy,
Edward Harris Mealy,
William Charles Metcalf,
John Floyd Miller,
William Eldred Nolan,
Gurdon Tyler Pollard,
Walter Percy Poole,
John Maurice Rehberger,
John McCullough Rife,
Harry Rufus Ruse,
Paul Edward Schaun,
John Henry Sirich, Jr.,
John Smith,
Herbert Turner Snyder,
George Creamer Wilcox.

CLASS OF '99.

Charles E. Allen,
William B. Boettinger,
Harrison Brent,
Hugh W. Brent,
Edward Goodnow Clayton,
Edward P. Cooke,
Charles C. Crockett,
William W. Cushing,
Arthur Councilman Davis,
Charles H. Demitz,
Roland S. Focke,
Harry B. French,
Robert B. Harper,
Charles W. Held,
Ira Johnson,
George A. Knapp,
Walter B. Lang,
Harry Lowenthal,
George P. McCeney,
William E. McCord,
Marion H. McCoy,
Charles E. Mencken,
Charles T. Owens,
Edw. L. Schaun,
Harold B. Vincent,
Joseph A. Ward,
Charles C. Lucke,
John N. McCleester,
Blakely A. McDonnell,
Edwin G. O'Connor,
William Taylor Phipps,
Emanuel J. Sedlacek,
Frederick C. J. Sternat.
Joseph R. Walter,
William C. Whelan.

CLASS OF '00.

John Walter Fred. Blizard,
Roy Stevenson Houck,
Galt Fayette Parsons,
Gustav Frederick Linck,
Horace Kirk Faust,
Thomas Osborn Wansleben,
Samuel Moore Johnson,
Luther Chase Wright,
Walter Bowen Buttner,
Morgan Moore,
John Charles Masopust,
Walter Groverman,
Lawrence Gunton Allbutt.

CLASS OF '01.

Joseph M. Beehler,
C. Ernest Conway,
William M. Demitz,
Charles F. Goob,
Richard G. Harris,
Irving C. Hess,
Charles W. Hoppert,
Carlisle L. Hubbard,
Edward E. Johnston,
Thomas H. Kenney,
Charles E. Lane,
Andrew J. Lowndes,
Ross E. Lynch,
Allen L. Malone,
Richard E. Marston,
Harry Mehrling,
John A. Raidabaugh,
T. Warden Rinehart,
William B. Rosenthal,
Edward Samuel,
John C. Siegle,
Walter H. Tapman,
Sidney C. Vincent,
George P. von Eiff,
Ernest B. Walton,
Arthur S. Weiss,
George K. Yost,
Philip H. Zipp.

POST-GRADUATE CLASS OF '02.

(Four Year Course.)

Joseph M. Beehler,
C. Ernest Conway,
Irving C. Hess,
Andrew J. Lowndes,
Allen L. Malone,
John A. Raidabaugh,
Sidney C. Vincent,
George P. von Eiff,
Philip H. Zipp.

CLASS OF '02.

Joseph A. Baldwin,
Frank O. Boyd,
John B. Cautley,
Robert Dall,
William L. De Baufre,
John K. Flickenschildt,
Walter M. Gieske,
Donald S. Hays,
Joseph T. Henthorn,
John S. Hess,
I. Seeley Jones,
D. Frank Lamble,
LeRoy M. Langrall,
H. Quimby Layman,
John G. M. Leisenring,
William N. Michael,
Charles A. Pettit,
William S. Samuel,
G. Forney Shryock,
Charles F. Yardley.

POST-GRADUATE CLASS OF '03.

(Four Year Course.)

John B. Cautley,
Robert Dall,
William L. De Baufre,
John K. Flickenschildt,
Walter M. Gieske,
Donald S. Hayes,
John S. Hess,
I. Seeley Jones,
LeRoy M. Langrall,
H. Quimby Layman,

Specials { Arthur C. Davis,
Charles A. Pettit.

CLASS OF '03.

Elmer Armiger,
Paul Backhaus,
Oscar F. Benjamin,
Owen C. Blades,
Harry N. Brannan,
Frank B. Burton,
William N. Crisp,
John W. Dorsey, Jr.,
Christopher J. Frank,
Milton H. Gross,
Harold M. Parsons,
Ernest M. Poole,
J. McDonnell Reid,
Martin J. Reynolds,
Edward Hering,
Charles E. Herth,
James B. Jones,
Milton Kraemer,
Herman Lucke, Jr.,
Edmund C. Lynch,
Arthur B. Marston,
Harry M. Mason, Jr.,
Sidney Newhoff,
Manly P. Northam,
August H. Schaaf,
Howard I. Schultz,
George F. W. Sims,
Wilmer T. Stone.

POST-GRADUATE CLASS OF '04.

(Four Year Course.)

Paul W. Backhaus,
Harry N. Brannan,
William N. Crisp,
Edward Hering,
James B. Jones,
Milton Kraemer,
Harry M. Mason, Jr.,
J. McDonnell Reid,
Martin J. Reynolds,
George F. W. Sims,

Specials
- Frank B. Burton,
- H. Milton Gross,
- August H. Schaaf.

CLASS OF '04.

Chester A. A. Albrecht,
James B. Arthur,
Marion V. Bailliere,
Joseph Bowes, Jr.,
Andrew K. Brumbaugh,
Clarence C. Clickner,
Edward C. Cromwell,
Frederick L. Dixon,
Charles A. Edel,
Frank B. Fifer,
Emanuel Fritz,
George Gittelsohn,
J. Lyell Gressitt,
Edward J. Hecker,
John H. Hills,
Harry J. Hodes,
Benjamin F. Hoffacker,
Harry V. D. Hunt,
William C. Hurley,
Charles A. Langrall,
Herman W. Lasser,
Daniel J. Leary,
Leon Marmor,
Samuel May,
John L. Mosher,
Charles P. Niederhauser,
Robert G. Pangborn,
Massimo Pisani, Jr.,
George S. Robertson,
George M. G. Schaefer,
Leon Small,
Oscar E. Smith,
Marion Steinberger,
Harry D. Thurlow,
Harry Waldorf,
Charles W. Whittle,
Edwin L. Willson,
Louis A. Witte,
William P. Wittmer,
Alexander H. Woollen.

POST-GRADUATE CLASS OF '05.

Chester A. A. Albrecht,
James B. Arthur,
Joseph Bowes, Jr.,
Edward C. Cromwell,
John W. Dorsey, Jr.,
Charles A. Edel,
Frank P. Fifer,
Emanuel Fritz,
J. Lyell Gressitt,
Richard G. Harris,
Edward J. Hecker,
John J. Hills,
Benjamin F. Hoffacker,
Harry V. D. Hunt,
Charles A. Langrall,
Samuel May,
John L. Mosher,
Robert G. Pangborn,
Massimo Pisani, Jr.,
Leon Small,
Marion Steinberger,
*Harry DeG. Thurlow,
Harry Waldorf
Edwin L. Willson.
Alexander H. Woollen.

* Deficient in Mechanics; allowed a re-examination in September and passed.

CLASS OF '06.

H. Roy Anderson,
Moses Appel,
Walter K. Bachrach,
Harry C. Becker,
J. Ralph Bolgiano,
William Wallace Boyd,
G. Herman Carl,
Willis B. Clemmitt,
Charles H. Dorsey,
George Erck,
Harry C. Finck,
Edwin Friese,
John R. Guttmann,
John R. Haswell,
Charles W. Henderson,
George F. Heubeck,
Ralph Holbrook,
Andrew C. Kemler,
Howard G. Lanahan,
George F. Lehmann,
Frank T. Leilich,
Harold M. Lewis,
Bernard A. McAbee,
Carl F. Meyer,
*Sidney D. Mitchell,
Ferdinand Oppenheimer,
John G. Pertsch, Jr.,
Lewis W. Porter,
John T. Ridgely,
John C. Schirmer,
Edward K. Stembridge,
David B. Stewart, Jr.,
Levin H. Stewart,
Israel E. Stolberg,
Frank T. Suman,
*Nicholas C. Thalheimer,
Raymond M. Weaver,
George F. Wennagel,
George F. Wieghardt,
Phillip H. Williamson,
Walter B. Wills.

*Deficient in Steam Engineering; allowed a re-examination in September and passed.

CLASS OF '07.

Theodore Ascherfeld,
Ludwig Aull,
Emil G. Bauersfeld,
†R. M. Bealer,
Alvin M. Bland,
Gustav Bornscheuer,
J. Daniel Brendel,
John N. Childs,
Wilmer A. Dehuff,
C. Lehman Downs,
Herbert S. Fairbank,
F. Donald Fenhagen,
Otto A. Geumann,
Charles E. Grimes,
Henry R. Gundlach,
G. Herman Guttmann,
Carroll R. Harding,
William Hartman,
Horace K. Hayden,
Harry L. Hess,
F. Merrill Hildebrandt,
Fernando Janer,
Harry B. Joyce,
John P. Kenney,
Charles Krausse,
‡W. H. Kruger, Jr.
William G. McLaughlin,
Laurence F. Magness,
J. C. Manning,
Lawrence G. Miller,
Charles E. Mitchell,
Serafin M. Montesinos,
George T. Mumma,
Marcus Newhoff,
Samuel P. Nixdorf,
Arthur Norden,
Edwin H. Nordmann,
Charles J. Rasch,
Charles J. Ritterhoff,
Ernest Rodemeyer,
Arthur H. Schultz, Jr.,
Nelson Schuster,
Frederick B. T. Siems,
V. Bernard Siems,
Charles Silver,
Samuel F. Tapman, Jr.,
T. Leonard Walter,
Bernard Wich,
R. Mason Wilhelm,
Julius Zieget.

†Deficient in Calculus: allowed a re-examination in September and passed.

‡Deficient in French: allowed a re-examination in September and passed.

CLASS MEMORIALS.

Framed Portrait of Dr. Henry A. Rowland. Presented to the Institute by the Fourth Year Class of 1903.

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